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# The potential of Automatic Speech Recognition for fostering pronunciation learners' autonomy

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**The potential of Automatic Speech Recognition for fostering pronunciation learners'  
autonomy**

by

**Shannon M. McCrocklin**

A dissertation submitted to the graduate faculty  
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Applied Linguistics and Technology

Program of Study Committee:

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Ames, Iowa

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## **DEDICATION**

For my father, who always pushed me to think critically, and my mother, who helped me learn to study effectively. I wouldn't have ever gotten this far without you.

## TABLE OF CONTENTS

<b>LIST OF TABLES.....</b>	<b>v</b>
<b>LIST OF FIGURES.....</b>	<b>vi</b>
<b>NOMENCLATURE .....</b>	<b>vii</b>
<b>ACKNOWLEDGEMENTS.....</b>	<b>viii</b>
<b>ABSTRACT.....</b>	<b>ix</b>
<b>CHAPTER 1: INTRODUCTION.....</b>	<b>1</b>
Statement of the Problem .....	1
Purpose of the Study .....	3
Significance of the Study .....	4
<b>CHAPTER 2: LITERATURE REVIEW .....</b>	<b>5</b>
Traditional Pronunciation Teaching .....	5
Autonomy .....	8
What is autonomy? .....	8
Value of developing autonomy.....	11
Fostering autonomy .....	14
Technology and Autonomy.....	19
Technology for pronunciation learning .....	20
Issues to address in researching technology for developing autonomy in pronunciation learning.....	23
Research Questions.....	24
<b>CHAPTER 3: METHODOLOGY .....</b>	<b>25</b>
The Pronunciation Workshops.....	25
Topics .....	25
Workshop design .....	28
Participants .....	33
Methods for Evaluation.....	34
Surveys .....	36
Interviews.....	39
Language learning logs .....	40
Focus groups .....	40
Data Analysis.....	41
Questions 1 and 3: Quantitative.....	41
Questions 2 and 4: Qualitative.....	42
Validity .....	43
<b>CHAPTER 4: RESULTS .....</b>	<b>46</b>
Beliefs of Autonomy .....	46
Experimentation .....	49
Capability .....	59
Motivation .....	60
Dependence .....	62
Autonomous Learning Behaviors.....	66
During the workshop.....	67
After the workshop .....	69

Choosing to continue or discontinue use of ASR .....	71
The dream ASR program.....	78
<b>Summary of Results .....</b>	<b>79</b>
<b>CHAPTER 5: DISCUSSION AND CONCLUSIONS.....</b>	<b>81</b>
<b>Discussion .....</b>	<b>81</b>
Limitations .....	90
Implications for teachers.....	91
Implications for software developers .....	93
Implications for researchers .....	94
Directions for future research .....	96
<b>Conclusions .....</b>	<b>98</b>
<b>REFERENCES .....</b>	<b>100</b>
<b>APPENDIX A: STUDENT GUIDE TO USING WSR .....</b>	<b>107</b>
<b>APPENDIX B: PRE-WORKSHOP SURVEY .....</b>	<b>109</b>
<b>APPENDIX C: POST-WORKSHOP SURVEY .....</b>	<b>112</b>
<b>APPENDIX D: DELAYED POST-SURVEY.....</b>	<b>114</b>
<b>APPENDIX E: POST-WORKSHOP INTERVIEW QUESTIONS .....</b>	<b>115</b>
<b>APPENDIX F: LEARNING LOGS.....</b>	<b>116</b>
<b>APPENDIX G: FOCUS GROUP QUESTIONS .....</b>	<b>117</b>
<b>APPENDIX H: AVERAGE RESPONSE SCORE FOR EACH LIKERT SCALE ITEM BY GROUP (COMPLETE WITH SD).....</b>	<b>118</b>
<b>APPENDIX I: STUDENT GUIDE SHEET FOR WEEK 1 PRACTICE WITH WSR.....</b>	<b>119</b>

## LIST OF TABLES

<b>Table 1.</b> Diagnostic Scores for Each Sound Targeted in Workshop by Group.....	27
<b>Table 2.</b> Weekly Topics/Activities Covered by Group .....	33
<b>Table 3.</b> Participant Background Information.....	34
<b>Table 4.</b> Cronbach's Alpha Coefficient Results for Pre- & Post-Workshop Survey Items....	38
<b>Table 5.</b> Research Questions, Methods, and Analyses.....	43
<b>Table 6.</b> Average Autonomy Scores for Pre- and Post-Survey and Significance .....	47
<b>Table 7.</b> Average Response Score for Each Likert Scale Item by Group .....	48
<b>Table 8.</b> Average Time Spent on Required Activities for the Pronunciation Workshop Each Week by Group .....	68
<b>Table 9.</b> Average Time Spent on Elective Activities during the Pronunciation Workshop for Each Week by Group .....	69
<b>Table 10.</b> Autonomous Learning Behaviors by Group .....	70

## LIST OF FIGURES

<b>Figure 1.</b> Explanatory mixed methods design .....	35
<b>Figure 2.</b> Explanatory design for overarching research question.....	45
<b>Figure 3.</b> Changes in beliefs of autonomy from pre- to post-workshop survey.....	47
<b>Figure 4.</b> Changes in responses to “I have resources and tools that can help me work on my pronunciation,” and, “I can use technology to help me with my pronunciation” by group.....	49
<b>Figure 5.</b> Reactions to ASR use by group.....	52
<b>Figure 6.</b> Changes in responses to “I am aware of multiple strategies to practice my English pronunciation,” and, “I like trying new activities to improve my pronunciation” by group .....	55
<b>Figure 7.</b> Changes in responses to “I practice my pronunciation in English frequently,” and, “I avoid talking with others in English because I am concerned about my pronunciation” by group.....	57
<b>Figure 8.</b> Changes in responses to “I am capable of successfully practicing my pronunciation in English on my own,” and, “It is possible to improve my pronunciation in English” by group .....	59
<b>Figure 9.</b> Changes in responses to “I care about my pronunciation in English,” and, “I want to continue improving my pronunciation” by group.....	61
<b>Figure 10.</b> Changes in responses to “I need to hear a native speaker to know how to pronounce a word correctly,” and, “I need a native speaker to correct me on my pronunciation to improve” by group.....	63
<b>Figure 11.</b> Changes in response to "I need a teacher to help me to improve my pronunciation" by group .....	64
<b>Figure 12.</b> Time spent on required activities for the pronunciation workshop for each week by group.....	67
<b>Figure 13.</b> Time spent on elective activities for pronunciation workshop for each week by group .....	68

**NOMENCLATURE**

ESL	English as a Second Language
L1	First Language (native language)
L2	Second Language
F2F	Face-to-face instruction
ASR	Automatic Speech Recognition
WSR	Windows Speech Recognition



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## ABSTRACT

Despite ESL students frequently reporting a need or desire to work on their pronunciation in English, pronunciation is often downgraded as a teaching goal and often pushed aside in favor of other skills (Kelly, 1969; Lang, Wang, Shen, & Wang, 2012). Students that want to practice outside of class are likely to feel at a loss because they struggle to monitor their own speech and may not be able to get the feedback necessary to make improvements to their pronunciation. Students need skills, strategies, and resources that will allow them to work on their pronunciation on their own, less reliant on a teacher or school for pronunciation training. In effect, students need to learn to become autonomous learners of pronunciation. Automatic Speech Recognition (ASR) has great potential as a technology to help students get feedback on their pronunciation, allowing them to be more autonomous pronunciation learners. This study seeks to examine the effect of ASR on students' autonomous learning beliefs and behaviors.

Three groups, a control group (TRAD, n=15) which received traditional face-to-face (F2F) instruction, an experimental group (STRAT, n=17) which received traditional F2F instructions, but also minimal strategy training in ASR, and a second experimental group (HYBRID, n=16) which received hybrid instruction (half F2F with minimal strategy training and half working with ASR) were given a three-week pronunciation workshop on consonants and vowels of English known to be problematic for ESL students. Changes in beliefs of autonomy were measured through pre- and post-workshop surveys with Likert scale items as well as semi-structured interviews. Autonomous learning behaviors were monitored through self-reports of behavior during the course with language learning logs and after the course with a delayed post-workshop survey. Students explained choices to continue or stop working with ASR during a focus group at the end of the study.

Results showed that STRAT and HYBRID both significantly increased their beliefs of autonomy from the pre- to post-workshop survey (for STRAT  $p=.006$  and for HYBRID  $p=.013$ ), while TRAD did not ( $p=.727$ ). Students primarily pointed to ASR as the reason that they felt more capable of practicing their pronunciation on their own, stating that the ASR was useful for feedback because they could not hear their own errors when speaking. HYBRID reported significantly more time spent on autonomous pronunciation learning than STRAT and TRAD after the pronunciation workshop ( $p=.011$ ). HYBRID also reported significantly more use of dictation software for pronunciation practice after the workshop than STRAT ( $p=.041$ ).

## **CHAPTER 1: INTRODUCTION**

### **Statement of the Problem**

Students learning English as a second language often recognize a need or desire to work on their pronunciation. Unfortunately for these students, pronunciation is often treated as the “Cinderella” of language teaching (Kelly, 1969, p. 87), downgraded as a teaching goal and often pushed aside in favor of other skills (Lang, Wang, Shen, & Wang, 2012). With the emergence and success of Communicative Language Teaching as a language teaching approach, pronunciation lost importance in the eyes of instructors and was pushed out of many programs (Isaacs, 2009). While awareness of the impact of pronunciation began to resurface in the 1990s (see Morley, 1991), pronunciation is still rarely a focal point of language teaching (Isaacs, 2009; Lang et al., 2012). As pronunciation often ends up embedded in a speaking class, it often gets ignored when time constraints force instructors to make choices about what they can realistically cover. Students rarely get the amount of pronunciation instruction that they need or want.

Given these constraints, students need skills and strategies that will empower them to work on their pronunciation on their own, so that they will not be as heavily reliant on a teacher or school for their pronunciation training. In effect, students need to learn to become autonomous learners of pronunciation. Autonomy, first introduced to the field of language learning by Holec, is described as “the ability to take charge of one’s learning” (1981, p. 3). Autonomous students have the ability to choose what they want to learn, make progress in learning (acquire knowledge and skill), and monitor their own learning. Autonomy has long been held as a language learning goal, given that it empowers students (Benson and Voller, 1997) and leads to higher learning achievement and motivation (Dickinson, 1995; Furtak & Kunter, 2012; Murray, 1999). While many agree that autonomy is important for student development, few resources provide

straightforward ideas, strategies, or tools that teachers can use to help their students become more autonomous, particularly in the realm of pronunciation. The question then simply becomes, “How can we help pronunciation learners become more autonomous?”

Traditional pronunciation teaching does not seem adequate to prepare students to work on their pronunciation on their own. Many pronunciation classroom activities still rely on the teacher to model correct pronunciation and to monitor, evaluate, and give feedback on student production. Pronunciation teachers also often rely on drills or controlled production activities, giving students little room for free expression or communicative practice. These types of pronunciation classes seem unlikely to foster student autonomy because students are not encouraged to develop skills or strategies for monitoring or evaluating their own pronunciation and are given very little room for free experimentation with the language and specifically their pronunciation.

Further, developing autonomy in pronunciation learning is arguably more difficult than in other language skills. Pronunciation improvement is a complex task. In addition to developing the knowledge of the sound system of English (e.g. when sounds are appropriate, how those sounds are created and what makes them different from other English sounds, how sounds merge together in speech), students must learn to control their vocal apparatus to make those sounds. This requires practice and feedback, but second language (L2) students struggle to monitor themselves. Students must create aural discrimination categories appropriate to the L2, while research has indicated that, for most language learners, sounds in an L2 are filtered through the phonological system of the first language (L1) (Beddor & Strange, 1982; Blankenship, 1991; Flege, Munro, & Fox, 1993). The ability to get feedback on pronunciation is critical for autonomy (Sheerin, 1997) and learners struggle to get feedback from other learning strategies,

such as covert rehearsal or even engaging in conversation with native speakers. In covert rehearsal, private practice out loud while monitoring one's own speech, students are likely to struggle to hear their own errors. When speaking with native speakers, although the native speakers may notice an error, they may be focused on understanding the meaning of the non-native speaker and may not wish to interrupt the flow of conversation unless the pronunciation leads to a communication breakdown. There is a great need for practical tools and strategies that will allow students to practice their pronunciation and get feedback.

### **Purpose of the Study**

This research study seeks to examine the use of technology, specifically Automatic Speech Recognition (ASR), as part of a pronunciation workshop in the hopes of empowering students to practice and improve their pronunciation on their own. ASR technology is behind many software programs for language learning, such as *Rosetta Stone*, but also surrounds us in daily life through Siri for the iPhone and call centers for large businesses. One particular form of ASR, dictation programs such as *Windows Speech Recognition* (WSR) for PCs, could potentially provide students with the feedback needed to improve pronunciation, allowing students to work autonomously, while also offering flexibility, allowing students to direct their learning and bring any desired materials into practice with the program.

Further, this study seeks to examine two different ways of incorporating ASR into a classroom: minimal strategy training added to a traditional face-to-face course, and a hybrid design with half of the class work performed through the computer and ASR, specifically WSR, to identify any differences this may create in students' beliefs of their own autonomy and in students' self-reported autonomous learning behaviors.

### **Significance of the Study**

While this study is heavily motivated by my own pronunciation teaching and learning experiences, findings from this research study will have direct implications for all language teachers. While there is agreement that autonomy is important in language learning, much of the previous research has not investigated ways to help students develop autonomy in their pronunciation learning. This study shows that introducing ASR is a realistic, easy, and accessible approach for teachers to help students develop beliefs of autonomy and to empower them to be more effective learners outside of the classroom. Further, it shows that through repeated practice with an ASR program, provided through the hybrid design, students reported more autonomous learning behaviors after the pronunciation training ended, spending more time on pronunciation work and using ASR more frequently.

## **CHAPTER 2: LITERATURE REVIEW**

While there is agreement that autonomy is an important language-learning goal, there is little research into how to foster autonomy in pronunciation learning. This chapter examines the state of traditional pronunciation teaching, including the special challenges faced by pronunciation learners and issues in developing autonomy, surveying what autonomy is, why autonomy is important, and how to foster it. The chapter then explores the potential of ASR for fostering autonomy in pronunciation learners, concluding with four research questions addressing the effectiveness of ASR in fostering autonomy.

### **Traditional Pronunciation Teaching**

Traditional pronunciation teaching involves mostly face-to-face classroom instruction with the teacher leading the class in pronunciation activities. Historically, traditional pronunciation classes have relied heavily on drills or very controlled production activities in which the teacher provides feedback. While pronunciation-teaching methods continue to evolve, many pronunciation classroom activities still rely on the teacher to model correct pronunciation and to monitor, evaluate, and give feedback on student production. Also, pronunciation teachers still often rely on drills or controlled production activities, giving students little room for free expression or communicative practice. Of the ten main teaching techniques introduced by Celce-Murcia, Brinton, and Goodwin (2010) for teaching pronunciation as part of the Communicative Approach (p. 9-10), only one, “recording’s of learner’s production” clearly mentions making use of the student in the evaluation. Most of the other techniques, such as “listen and imitate” and “minimal-pair drills” rely heavily on the teacher to be the model of pronunciation and the monitor of student production. These types of pronunciation classes seem unlikely to foster student autonomy because students are not encouraged to develop skills or strategies for



monitoring or evaluating their own pronunciation and are given very little room for free experimentation with the language and specifically their pronunciation.

Work by Dickerson (1994) and Sardegna (2009) suggested that students can be empowered with a combination of predictive rules about language and a language learning strategy, covert rehearsal. Students can be taught predictive rules, such as links between spelling and pronunciation to help them predict which sound is appropriate or word stress patterns to predict which syllable in a word should take the main stress. Students can also be introduced to and encouraged to try the language learning strategy, covert rehearsal, in which students practice on their own, monitoring the practice language they produce with the predictive language rules they have been taught.

Pronunciation learning, however, is complicated by the fact that pronunciation is not simply an issue of knowledge. While the links between spelling and pronunciation mentioned above may be considered knowledge, in pronunciation it is not enough to know what sound needs to be made in a particular word or which syllable takes the main word stress. A student of pronunciation must learn not only when sounds are appropriate, but also how to control motor functions to create those sounds. Additionally, monitoring one's own pronunciation requires the ability to create aural discrimination categories appropriate to the L2. Instead, research has indicated that, for most language learners, sounds in an L2 are filtered through the phonological system of the L1 (Beddor & Strange, 1982; Blankenship, 1991; Flege, Munro, & Fox, 1993). Filtering through the L1 can lead an L2 learner to make distinctions that are inappropriate for the L2 and may prevent learners from identifying pronunciation errors when they make them.

Even with knowledge of which sound is appropriate and a trained ear, students are still left needing to learn how to control their vocal apparatuses to accurately produce sounds. This

requires practice and feedback. While there is potential for such practice and learning to be autonomous, the task may be daunting or overwhelming to students, especially those not familiar with tools or strategies that can help them. In traditional pronunciation teaching approaches such practice is generally accomplished through controlled activities in which the teacher serves as the model of “good” pronunciation and the monitor of student pronunciation. Teachers can encourage experimentation within the safe boundaries of the classroom, but may not be able to help students practice outside of the classroom. Without a teacher and without the ability to hear differences between sounds, students may feel powerless to practice, monitor, and improve their pronunciation on their own.

Students need strategies, skills, or tools that empower them to experiment with pronunciation without relying on the teacher for constant monitoring and feedback, tools that will help students become more autonomous as pronunciation learners. Yet there is very little research that has examined autonomy in pronunciation learning. After extensive searching, only two research studies, Kruk (2012) and Szyszka (2006), surfaced that specifically aimed to examine autonomy in the realm of pronunciation. Books with a focus on autonomy tend to avoid pronunciation topics, such as Allford and Pachler (2007), which focused mostly on literacy and grammar. Similarly, Benson (2011), in making recommendations for technologies to use in the classroom, highly rated or recommended lessons using WebQuests, Chatbots, and Web 2.0 writing (such as blogging) based on the criteria that they allow the learner to control main decisions in the learning process, allow broad availability to authentic input, and allow more interactivity within the language (p. 152). Notice, however, that these technologies rely heavily on reading and writing. Even chatbots, whose name may mislead people to think of speaking and

listening skills, are typically presented and used with writing. Few sources address how students can become autonomous learners in the realm of pronunciation.

## **Autonomy**

### **What is autonomy?**

While the word “autonomy” traditionally conjures the ideas of freedom and independence, it has specific meaning when applied to language learning. Henri Holec, the first to apply autonomy to the field of language learning, defined autonomy as “the ability to take charge of one’s learning” (1981, p. 3). Holec stated that an autonomous learner would have all responsibility for decisions relating to learning such as defining learning objectives, choosing content and progression through content, picking approaches and even practices, monitoring progress, and evaluating acquisition (1981). Practitioners have since recognized, however, that Holec’s definition tends to overlook or discount the cognitive processes underlying autonomy (Benson, 2009), and other definitions of autonomy have emerged.

Benson laid out three versions of autonomy, the technical, the psychological, and the political (Benson and Voller, 1997). In Benson’s definitions, the technical version of autonomy emphasizes learner training to equip students with learning strategies in order to be prepared for situations in which learners need to take charge of their own learning (p. 14, 19). Psychological versions consider autonomy to be a “capacity” and therefore focus on developing the “attitudes and abilities” that would allow learners to take control of their learning (p. 14). Political versions of autonomy relate to issues of shifting control to students for the content to be learned and the methods to be used (p. 14).

In political versions, autonomy is often seen as a right. Often these politicized views link autonomy to “empowerment” (Benson and Voller, 1997, p. 7) or “emancipation” (Pennycook,

1997, p. 46) and research into empowerment may view autonomy as one aspect of empowerment (Warschauer, Turbee, & Roberts, 1996). Such views of autonomy stem from critical approaches to language learning, those in which language is not seen as neutral, but instead seen as a means of supporting certain kinds of knowledge and hiding or suppressing others (Benson, 1997, p. 22). Critical approaches are concerned with “addressing radical concerns, the abuses of power in intercultural contexts, in the acquisition of languages and in their circulation” (Phipps & Guilherme, 2004, p. 1). A critical approach leads to autonomy being defined in relation to control: “Critical approaches to language pedagogy therefore tend to emphasize issues of power and control within language. Learning to use a language also involves learning about the language and its social contexts and how both can be changed” (Benson, 1997, p. 22).

One of the most influential proponents for autonomy in education, Paulo Freire, promoted autonomy as a principle goal of critical pedagogies (Dale & Hyslop-Margison, 2010). He argued that such autonomy would help to emancipate students and allow them to be life-long learners. Influenced by Freire’s work, Pennycook (1997) argued for a “more socially, culturally, and politically engaged version of language education than that commonly assumed by what [he] see[s] as the mainstream version of learner autonomy” (p. 49). Pennycook suggested eleven methods for the promotion of autonomy in language learning:

1. Authentic interaction with the target language and its users
2. Collaborative group work and collective decision making
3. Participation in open-ended learning tasks
4. Learning about the target language and its social contexts of use
5. Exploration of societal and personal learning goals
6. Criticism of learning tasks and materials

7. Self-production of tasks and materials
8. Control over the management of learning
9. Control over the content of learning
10. Control over resources
11. Discussion and criticism of target language norms

(1997, p. 33)

The striking problem that emerges from this list of approaches is that while Pennycook encouraged more discussion of societal expectations as a part of language learning and discussed control in language learning, it is not clear how a student in such a classroom would actually develop the language necessary to engage in such discussions or develop the knowledge or skills to be able to effectively control learning in the classroom. Political versions of autonomy often lead to what Allford and Pachler (2007) called radical approaches to autonomy, “in [which], emphasis is laid on the learner’s right to autonomy and on her assumption of full responsibility for her learning” (p. 14). They criticized radical positions, however, for often confusing a right to be autonomous with the ability to do so (p. 14).

In pronunciation, students are likely to be at a loss if simply handed the reins of their language learning. While Pennycook dismissed strategy training and self-access work as insufficient and Benson (1997) claimed that such training can even perpetuate established ideologies by pushing students to work with established methodologies (p. 31), there seems to be very little attention paid in these radical approaches to developing skill in the language or to developing the necessary skills to be able to work autonomously to improve language use. In gradualist positions, on the other hand, autonomous language learning is seen as a long-term goal, something to be developed eventually. Skills in autonomous language learning, as well as

proficiency and skill in the L2, are developed through study and practice. The teacher is also often considered to play a significant role in this process, providing training and guidance (Allford & Pachler, 2007, p. 14).

It is important to note that while theorists and researchers may take different approaches, these positions need not be mutually exclusive; a student may have a right to autonomy but may also need training to be an effective and autonomous learner. In this study, it is acknowledged that students have a right to autonomy in their language learning, but it is also recognized that students may need guidance, practice, and encouragement to become effective autonomous learners. Thus, this study follows a gradualist approach, with the long-term objective of helping students develop their capacity for autonomous language learning by equipping them with strategies and tools that assist in autonomous learning. Therefore, this study aligns much more with Benson's technical versions of autonomy, which emphasize learner training to equip students with learning strategies, and psychological versions, which focus on developing the "attitudes and abilities" that allow learners to take control of their learning (p. 14).

### **Value of developing autonomy**

Research that aims to help students develop and foster autonomy often highlights the educational benefits of autonomy, that is, the learning it enables. Learner autonomy is seen by many "as a means to the end of more effective language learning" (Benson and Voller, 1997, p. 13). Student autonomy allows students to work more effectively on their own, allowing them to make progress not dependent on a teacher for constant instruction and direction. Little (2007) went a step further, contending that all learning can be seen as autonomous, because while a teacher can control what is taught, in the end, the teacher cannot control what is learnt (p. 7). While all learning may be autonomous, most learners have not developed the willingness to

experiment or the ability to plan, monitor, and evaluate their own learning; they are not effective autonomous learners.

Autonomous learners have been found to have higher motivation and higher learning achievement. Classes that work to foster autonomy have also been found to positively affect students' motivation and achievement (Dickinson, 1995; Furtak & Kunter, 2012; Murray, 1999). In Furtak and Kunter's study, 51 seventh grade science students participated in a study on motivation and autonomy. The participants took achievement tests, pre- and post-questionnaires on motivation, and were video-taped during lessons in order to track autonomous learning. The researchers found that in the courses where students reported high levels of autonomy support students had higher achievement scores and reported more motivation. In the field of language learning, Dickinson (1995) surveyed several studies and concluded that there is sufficient evidence to suggest that language learning achievement and motivation are dependent on learner autonomy, in particular, that learners are accountable for their learning, are capable of controlling their learning, and see their successes or failures as a result of their own effort and practice.

Deci and Ryan (1985) proposed a link between autonomy and intrinsic motivation, claiming that students who are able to self-determine all or some of the learning content or methods are more likely to be driven by intrinsic motivation. Students with intrinsic motivation are not being pushed forward in their learning by a teacher's homework, grades, or tests (extrinsic motivation). Instead, intrinsic motivation stems from an interest in the task itself. Brown (2007) stated, "The most powerful rewards are those that are intrinsically motivated within the learner. Because the behavior stems from needs, wants, or desires within oneself, the behavior itself is self-rewarding; therefore, no externally administered reward is necessary" (p.

68). Studies have shown that students with intrinsic motivation are likely to have higher achievement than those with extrinsic motivation (Deci and Ryan, 1985).

These benefits are consistent for all students, regardless of cultural background. Cultural differences have led some theorists to worry whether, “the principles and practice on which ‘autonomous’ and ‘self-directed’ learning schemes are based ethnocentric” (Riley, 1988, p. 14). Schmenk (2005) explained that ethnocentricity regarding autonomy results from two forms of culture blindness, 1) “neglecting the fact that autonomy is indeed a cultural construct” (p. 108) that was developed from Western ideas of freedom and 2) if autonomy were to be promoted because it ignores the social, cultural, and educational backgrounds of the students it claims to help (p. 108). These theorists have been particularly concerned about Asian cultural contexts, which are thought to value teacher-led instruction and rote-memorization.

Kennedy (2002), however, claimed that many of these concerns come from a misunderstanding of Asian cultures. Kennedy explained that while Confucianism encouraged building relationships through compromise, it also encouraged individuality in learning. Kennedy quoted Lee (1996) who explained Confucian ideals stating, “the purpose of learning is to cultivate oneself as an intelligent, creative, independent, autonomous being” (p. 34, as cited in Kennedy, 2002). Kennedy also argued that while students in China are often expected to memorize without questioning authority, memorization is likely a useful strategy for the test driven education of China. This does not mean it is a preferred learning style.

In addition, research has indicated that autonomy has a positive relationship with school achievement and well-being in Asian contexts. Vansteenkiste, Zhou, Lens, and Soenens (2005) investigated Chinese students’ autonomy to determine if there was a relationship between motivation, well-being, test scores, and drop out rates. Reported autonomy positively correlated



with high test scores, motivation, and well-being, while it negatively correlated with drop-out rates.

Many of these studies, however, did find that students had differing levels of readiness for autonomy and different comfort levels with autonomous learning (Kennedy, 2002; Luke, 2006). Luke (2006) pointed out that these students may feel uncomfortable with the idea of directing their own learning. Students raised in more traditional teacher-led classrooms may even devalue autonomy, appreciating more teacher-led (spoon-fed) approaches (Ming & Alias, 2007). Cotteral (1995) explained that past experiences with language learning were one of the six main measures of readiness for autonomy, along with beliefs about the role of the teacher and feedback, the learner's confidence and sense of independence, and approach to language study. Research, though, has shown that students can adapt to and appreciate autonomous learning experiences (Kennedy 2002; Kember, 2000; Lee, 1998).

Then, while autonomy can have several benefits—empowering students, enabling life-long learning, enhancing motivation, and increasing achievement—it is important to note that, due to different experiences and differing levels of capability, students may have differing levels of readiness for autonomy. It is important, therefore, to find successful ways to foster student autonomy for a diverse population of learners.

### **Fostering autonomy**

For Schwienhorst (2008), the many aspects of autonomy all revolve around and depend on experimentation. Schwienhorst, who also takes a gradualist approach to autonomy, stated that learners need to become reflective and critical of their own learning, that learners need to communicate and collaborate in English, and that “learners need to become experimenters with and explorers of language and language learning in a laboratory-like, stress-free environment”

(2008, p. 9). He continued by linking most of the traditional ideas associated with autonomy, such as control, to experimentation. He said that students “need to understand that they themselves need to take control of and assume responsibility for their learning. They need to plan, monitor, and evaluate their own process of language learning. In summary, this involves experimentation” (2008, p. 9). Using Schwienhorst’s framework, any approaches to fostering autonomy should allow for and encourage experimentation with the language as well as with language learning activities and methods.

Fostering autonomy through experimentation, then, requires two basic steps: preparing students with knowledge of pronunciation learning strategies that enable experimentation, and encouraging students to work on their pronunciation independently outside of class.

#### Strategies for fostering autonomy

Strategies are often mentioned as part of developing autonomy, such as in Benson’s technical version of autonomy, which emphasizes learner training to equip students with learning strategies (Benson & Voller, 1997, p. 14). Although work in strategy development and training is often discussed separately from autonomy, strategies share many overlapping features and goals with autonomy. Oxford (1990) stated that language-learning strategies are important because they are “tools for active, self-directed learning” (p. 1). Oxford continued by defining language learning strategies as “specific actions taken by the learner to make learning easier, faster, more enjoyable, more self-directed, more effective, and more transferrable to new situations” (p. 8). While some strategies, for example memorization strategies such as mnemonic devices (“Roy G. Bov” for the seven colors of the spectrum) are familiar to many, when it comes to language learning it can be overwhelming to try to learn on one’s own. Language learning is far more complicated than a simple issue of memorization. Going beyond memory strategies, Oxford

(1990) split strategies for language learning into five additional types: cognitive strategies, such as practicing; compensation strategies, such as guessing intelligently; metacognitive strategies, such as planning learning; affective strategies, such as encouraging yourself; and social strategies, such as asking questions. Clear links begin to emerge between cognitive strategies (such as practice) and the experimentation required for autonomy and between metacognitive strategies (such as planning and evaluating learning) and definitions of autonomy, such as Holec's (1981), which includes choosing content and progression through content, picking approaches and practices, monitoring progress, and evaluating acquisition.

Oxford (1990) advocated for training students in strategy use because, as she pointed out, students cannot just be “spoon-fed” information and suddenly be successful users of a language (p. 201). Training can be accomplished through “awareness training,” presenting information about strategies and highlighting how such strategy use can help students be more effective language learners, as well as actual practice with the strategies (p. 203).

#### Self-access work for fostering autonomy

The second step to fostering autonomy through experimentation is encouraging students to engage in practice outside of class. Self-access work, usually done in labs or with software, has long been associated with autonomy and may provide opportunities for extensive experimentation. Littlewood argued for the importance of self-access work in developing autonomy, stating:

Since independent work involves the creation of personal learning contexts, self-access also performs an important role in the development of the learner's autonomy as a person...By a similar process of extension, the learning strategies developed in self-

access work lead to wider range of communication strategies and thus further the learner's autonomy as a communicator (1997, p. 84).

Self-access work, though, has had a troubled past with autonomy: "Some have misunderstood [autonomy] as synonymous with self-access learning" (Schwienhorst, 2008, p. 11). Self-access work, when misused, leads students to work autonomously in the sense that they work alone and at their own speed, but may prevent them from making choices in the planning or direction of their learning.

When properly designed to allow for experimentation, self-access work has been seen as a natural means to developing autonomy (Benson & Voller, 1997, p. 9). Sheerin (1997) highlighted self-access as a "practical means" for encouraging more active roles for students in their own learning (p. 65). Benson and Voller were quick to point out, however, that research has indicated that self-access work without proper support and guidance may cause students to become more dependent on the materials that guide the work (1997, p. 9). Without support and guidance, students may not see the purpose of the activities or may feel overwhelmed by the choices or tasks in front of them. This problem was encountered in Furtak and Kunter (2012). While trying to provide autonomy-fostering teacher guidance, they found that the students who were in the class settings meant to foster autonomy were not the ones that felt the most autonomous. The researchers concluded that students in the autonomy-fostering settings may have been overtaxed and may have seen the teacher's lack of involvement as a negative.

Many writers, however, still point to self-access work as one way to enhance opportunities for autonomous learning, but recognize that this type of work requires help and support to be successful. These authors then argue for a more gradualist approach, pointing out that self-access work is more likely to foster autonomy when both teachers and students are

adequately supported (Breen & Mann, 1997; Darasawong, Singhasiri, & Keyuravong, 2007; Toogood & Pemberton, 2007; Young, Hafner, & Fisher, 2007).

Teachers need support as they attempt to alter their teaching style. Traditional teaching is teacher led. Teachers tell students information, tell them what to do with it, and assess their performance in these controlled activities (sometimes called spoon-feeding). Many teachers interested in teaching for autonomy will need to shift their teaching style to be less directive and less controlling. This changing of roles can be a struggle for teachers, even if they are motivated to teach for autonomy. To provide teacher support, Young, Hafner, and Fisher (2007) recommended that teachers be provided with information about autonomous learning to expand their knowledge of the subject, that teachers be encouraged to engage in an independent learning environment to better understand the viewpoint of the students, and that teachers be provided with time to reflect on their experiences with learning autonomously and teaching for autonomy in their students.

Students also need ample support. Many students raised in traditional teaching settings will be unfamiliar with self-access and self-directed learning. Without adequate support, students may lack direction or become frustrated with setbacks. Students need to be sufficiently supported by direct teacher guidance and “indirect guidance through documents and worksheets” (Darasawong, Singhasiri, & Keyuravong, 2007, p. 171). The type of direction or guidance needed is likely to differ based on level of capability and experience with autonomy. Sheerin (1997) suggested that the type of teacher direction or guidance should be based on a constant re-assessing of the student’s abilities and needs. Sheerin also pointed out that part of the necessary support for self-access work is learner feedback; the learner needs to be able to get feedback, such as answers or suggestions for future work (Sheerin, 1997, p. 60). While a teacher may be

able to provide eventual feedback, technology, either through language labs or online resources, provides a language learning tool that can facilitate practice and provide immediate feedback.

### **Technology and Autonomy**

Technology, online resources and software, by allowing for both self-access work and feedback, allows students to experiment with the language more effectively. In the past, experimentation with the language usually meant seeking out opportunities to use the language for communication. For many students such encounters would induce language anxiety, “the worry and usually negative emotional reaction aroused when learning or using an L2” (MacIntyre, 2007, p. 565). Language anxiety can be a huge factor in the foreign language classroom, hindering fluency and acquisition (Horwitz, Horwitz, & Cope, 1986). Speaking, in particular, is often reported as the most anxiety inducing skill to practice (Horwitz, Horwitz, & Cope, 1986). MacIntyre (2007), exploring the Willingness to Communicate Framework, sets up anxiety (and subsequent avoidance) as the primary blockade between students and a willingness to communicate in their L2. Even students highly motivated to learn the L2 may avoid opportunities for communication and practice in the L2 in the presence of high anxiety.

Today, however, most students have access to technology, such as computers and mobile phones, which can allow for practice in a less threatening setting. Banafa (2008) found that work on computers was useful for pronunciation work because they “provide safe environments for practicing pronunciation and oral language” (p. 119). Most self-access work has been conducted through language labs with computers. Pennycook (1997), pointing to Freire’s work, highlights the needs for tools stating, “a critical pedagogy that aims to emancipate students must aim to help students to develop the tools to engage in the struggle themselves” (p. 46). Computers are one tool that students can utilize for accessing information as well as practicing with language

through online resources or software programs. Computers have long been linked to language learning as a useful tool for practice. Even with early computers, Illich (1971) proposed that technology may allow academic institutions or establishments that “serve personal, creative, and autonomous interaction” (p. 2).

While many researchers point out the potential for technology to allow for or foster autonomy, research to confirm technology’s actual role is rare but does seem to support this notion. Figura and Jarvis (2007) used diaries and interviews with students to track their use of technology over the course of a semester in which they were guided in autonomous learning and introduced to web-based technologies that aimed to help them with their language learning. Results indicated that students were able to use strategies and technologies presented to them and demonstrated “reasonable levels of autonomy” (p. 460). Using interviews, field notes, teacher-researcher records, and student projects, Luke (2006) found that students learning Spanish involved in an inquiry-based internet research project developed a greater sense of voice and autonomy than the course that was not allowed to negotiate topics for inquiry. Murray (1999), who introduced a pedagogy for autonomy using computerized language labs, found reported increases in student motivation, understanding of language learning (metacognitive knowledge), and self-confidence.

### **Technology for pronunciation learning**

Technology via online resources and software provides a potential tool to help with pronunciation learning. One of the few research studies examining autonomy in pronunciation learning, Kruk (2012), examined technology use for developing autonomy in pronunciation teaching. Kruk (2012), comparing an experimental group 1 (autonomy as goal) and experimental group 2 (traditional classroom controlled by teacher) and a control group (no instruction), found

that by providing students with computer based work, a choice of internet based activities on a particular pronunciation feature, experimental group 1 was able to outperform the other groups on tests and displayed more autonomy. Kruk concluded that this study “provide[d] a justification for using digital technology as a tool for promoting autonomy and teaching pronunciation” (p. 113).

Another technology that shows great promise for pronunciation self-access work is Automatic Speech Recognition (ASR), which allows students to experiment with the language in a safe, private setting: “[ASR] is an independent, machine-based process of decoding and transcribing oral speech. A typical ASR system receives acoustic input from the speaker through a microphone, analyzes it using some pattern, model or algorithm, and produces an output, usually in the form of a text” (Levis & Suvorov, 2014, p. 1). Many people now have had experience with an ASR program, either through automated telephone lines, Siri on the iPhone, or speech dictation programs. ASR is also built into many language learning programs such as *Rosetta Stone* (2013), *Tell Me More* (Auralog, 2013), and *Burlington English* (2014).

When used for pronunciation training, ASR is a tool that allows students to practice at their own speed, getting feedback from the words recognized. Although ASR has been criticized in dictation programs for low rates of accurate recognition for non-native speakers of the language (Coniam, 1999; Derwing, Munro, & Carbonaro, 2000), ASR systems have been improving in evaluation accuracy for non-native speakers. Programmers are making strides in accuracy by incorporating data about non-native speakers or the source language. Truong, Neri, de Wet, Cucchiarini, and Strik (2005) found that by focusing on frequent errors and providing information about the most common mispronunciations, program recognition of pronunciation errors on a text known by the program was raised to 85-95% using one method called the Linear



Discriminant Analysis. This work, however, was limited to only a few sounds known to be problematic to Dutch speakers and the users were limited to reading a text provided by the program. Following this work, Moustroufas and Digalakis (2007) used two different models, Gaussian Mixture Models and Hidden Markov Models, that worked off of two corpora, one of the target language (English) and one of the native language (Greek), to evaluate the pronunciation of uttered speech that was unknown to the program. They were able to develop a program that with only 10 sentences could give a valid pronunciation score (based on correlations with human raters). While this work allowed for evaluations of all sounds, this work still limited the program to one language background, Greek. Work to improve ASR's accuracy in evaluating continues and ASR programs geared toward non-native speakers have reasonably high levels of accuracy (Neri, Cucchiarini, & Strik, 2003, p. 1158).

Perhaps more importantly, though, compared to other systems as well as face-to-face courses, ASR seems to facilitate pronunciation improvement for diverse populations of learners. For example, Hincks (2003) utilized the ASR based program, *Talk to Me*, as a supplement to a course in Technical English. When students' progress was compared, using a pre-and post-test through the automated test, *PhonePass*, to a group that had also taken the class, but had not used *Talk to Me*, the program was found to be useful for students who had a strong accent entering the course. Neri, Cucchiarini, and Strik (2006) used an ASR based program for Dutch with 30 adult immigrant learners. They found the ASR based program useful for correcting errors (compared to the group that received no training and a group that received training that lacked feedback). ASR programs have also been found useful in helping children with pronunciation. Neri, Mich, Gerosa, and Giuliani (2008) focused on using ASR based CAPT systems with children (11 years old). The program word on pronunciation at the word level and results were compared against a

more traditionally taught group that received instruction from a teacher. Both groups improved on their pronunciation.

### **Issues to address in researching technology for developing autonomy in pronunciation learning**

Previous studies in ASR for pronunciation learning focused on student improvement, measuring accuracy gains with a pre- and post-test design. These studies did not focus on developing student autonomy and made no effort to measure changes in autonomy. There seems to be little overlap between research in autonomy and research into pronunciation. As mentioned previously, only two studies have examined the development of autonomy for pronunciation learning. Most work in autonomy research focuses on language learning more generally or writing and reading more specifically. Little of the literature on autonomy even acknowledges pronunciation as a skill to work on. There is a great need for further research that looks at ways of helping students foster autonomy in their pronunciation learning and practice.

Additionally, such work should measure changes in autonomy. In most of the work on technology and autonomy, researchers did not begin work by assessing starting levels of autonomy. These studies introduced a technology and looked for evidence of autonomous learning or asked students about their autonomy at the end of the study. Without an understanding of a learner's starting levels of autonomy, researchers cannot attribute any autonomous learning behavior to an intervention introduced in the study. Nguyen (2012) criticized past research in autonomy for not providing sufficient empirical evidence for claims. Research is needed that measures autonomy before and after an intervention to provide sufficient empirical evidence to support claims about the effect of an intervention. One of the goals of the present study, then, is to measure changes in autonomy before and after work with technology.

### **Research Questions**

This study examines whether a course that incorporates self-access work with ASR for pronunciation experimentation can help foster learner autonomy more than traditional pronunciation courses. Specifically, it asks these questions:

1. Does instruction incorporating ASR as a pronunciation learning strategy foster a higher self-reported belief of autonomy than traditional face-to-face instruction?
2. How do students account for changes in self-reported beliefs of autonomy?
3. Do students introduced to ASR report more autonomous learning behaviors (more time spent or more activities used for autonomous learning)?
4. How do students explain choices to continue or stop working with ASR after the course ends?

### **CHAPTER 3: METHODOLOGY**

This chapter describes the methodology used to determine if ASR helps to foster pronunciation learner autonomy. To assess different methods of instruction, the study was run in six sections of English 99L: Listening Strategies for Non-native Speakers of English at Iowa State University. English 99L helps students develop listening skills in English, improving comprehension of spoken English, developing strategies for listening to academic lectures in English, developing note-taking skills, and acquiring spoken vocabulary in English. As part of helping students improve comprehension, the course often features pronunciation topics that help students with micro-listening skills. For the study, a three-week pronunciation workshop was embedded in the course. The workshop covered vowels and consonants that frequently cause listening and pronunciation problems for students from numerous language learning backgrounds. The effectiveness of the pronunciation workshop for promoting autonomy was then measured through surveys, language learning logs, interviews, and focus groups.

#### **The Pronunciation Workshops**

##### **Topics**

The pronunciation workshop covered sounds likely to be problematic for students: the vowel pairs /ɛ/ vs. /æ/, /a/ vs. /ʌ/, and /i/ vs. /ɪ/ and the consonants /ɹ/, /θ/, /ð/, /ʒ/, and /dʒ/. Because this course was short, it was neither possible to cover comprehensively all of the contrasts problematic for all students, nor to design a course in advance without already enrolled participants that could target problems for the particular class. It was important, however, to ensure students could find as much of the training as valuable as possible so they would recognize a need for the training. This is more likely to happen if students do not have mastery of a sound or contrast. Thus, while functional load (Brown, 1988), which determines the

importance of a sound contrast by analyzing the number of minimal pairs it has the potential to make, was considered, it was determined that it was more important to choose sounds that were likely to affect most students.

To determine which vowel sounds were likely to affect the most students, Nilsen and Nilsen (2002) was used to identify the contrasts that are likely to be problematic to speakers of many languages because the contrast does not exist in that language. Then, because of the large Chinese student population at Iowa State, 52.07% of the international students (Iowa State University Fact Book, 2013), the sounds identified as most-widely problematic were checked for the inclusion of Chinese as one of the identified languages. Specifically, /ɛ/ vs. /æ/ was identified as the contrast problematic to the most native language backgrounds at 41 languages, /a/ vs. /ʌ/ was identified as the contrast second most problematic at 36 languages, and /i/ vs. /ɪ/ was third most problematic at 35 languages. Chinese was specifically listed for lacking each of the three vowel contrasts being addressed.

The consonants, /ɹ/, /θ/, /ð/, /ʒ/ & /dʒ/ were chosen because they are comparatively rare among the languages of the world and are likely to be problematic for many students, including Chinese students. Deterding and Poedjosoedarmo pointed out, “dental fricatives are not particularly common sounds in the world’s languages and so they tend to cause problems for many non-native speakers of English” (1998, p. 57). Similarly the rhotacized, voiced palato-alveolar approximant /ɹ/ is not common to many languages (Gimson, 1962; Yavas, 2006). English /ɹ/ is recognized as a sound that is particularly problematic for not only second language learners but also native speakers. (Chreist, 1964; Modisett & Luter, 1979). ESL students may also encounter problems with /ɹ/ because, while “r” is common in spelling in many languages, the letter “r” most commonly refers to a tapped, flapped, or trilled /r/ common of languages such

as Spanish and Italian or a uvular /ʁ/ as seen in German and French (Prator, 1967; Yavas, 2006). Furthermore, students from 11 language backgrounds including Chinese, Japanese, and Korean are likely to struggle with the distinction between /ɪ/ and /I/ (Nilsen & Nilsen, 2002; Prator, 1967). Thirty languages are presented by Nilsen and Nilsen that lack contrasts with /dʒ/ (when contrasted with several different sounds such as /dʒ/ versus /ʃ/ , /z/, /tʃ/, and /j/). The sounds /ʒ/ and /dʒ/ were also chosen because they are not a part of Mandarin or Cantonese phonology. While the Chinese dialects do have sounds that are “distantly similar” to /ʒ/ and /dʒ/, pronouncing the related Chinese sounds would be noticeable and “sound foreign” (Swan & Smith, 2001, p. 312)

Before beginning the workshop, students were also given a pronunciation diagnostic to highlight problem areas, help direct focus in pronunciation work, and enhance motivation. The diagnostic involved reading two dialogues that feature all of the targeted sounds as well as lists of minimal pairs for the targeted vowels. Eight tokens for each sound (or sound pair) were included and marked. The groups had similar diagnostic scores; the overall score for each group ranged was 64.8% for TRAD, 65.0% for STRAT, and 62.2% for HYBRID. Table 1 includes average diagnostic scores (as a percentage of total possible) for each sound or sound grouping included in the workshop.

**Table 1.** Diagnostic Scores for Each Sound Targeted in Workshop by Group

<b>Sound</b> ----- <b>Group</b>	<b>/θ/ &amp; /ð/</b>	<b>/ɪ/</b>	<b>/ʒ/ &amp; /dʒ/</b>	<b>/i/ &amp; /I/</b>	<b>/ɛ/ &amp; /æ/</b>	<b>/a/ &amp; /ʌ/</b>	<b>Overall</b>
<b>TRAD</b>	37.50	80.21	70.83	56.25	59.38	84.38	64.76
<b>STRAT</b>	42.50	80.83	72.50	59.17	62.50	72.50	65.00
<b>HYBRID</b>	36.54	77.88	69.23	64.42	57.69	67.31	62.18

To ensure consistency of rating on the diagnostic, 30% of the diagnostics were re-rated two weeks after the initial rating. Intra-rater reliability was assessed by Pearson’s correlation

coefficient, which showed a high-level of agreement (.869). Students were given feedback on their diagnostic recording that identified their problem areas; a sound was marked as a problem for the student if he or she presented at least two errors with the sound in the diagnostic. Students were provided feedback on the sounds they struggled with through the grading system of the course website, Moodle. While the focus of the study was not to measure production improvement, the diagnostic feedback when reported to students was useful in helping motivate students, providing areas to work on and showing the relevance of the workshop to students' pronunciation needs.

### **Workshop design**

Participants were separated into three groups: one control and two treatment groups according to the sections of 99L they were enrolled in. The first experimental group received minimal pronunciation learning strategy training and the second received the minimal strategy training as well as completed half of their work as self-access work with ASR. Two sections of 99L were included in each group. The particular sections assigned to be experimental or control were randomly chosen. Each of the three groups received different instruction methods.

- Control (1):
  - Traditional Face-to-Face (F2F) Course (TRAD)
- Experimental (2):
  - Mostly traditional F2F with minimal strategy training (STRAT)
  - Hybrid with minimal strategy training and technology/online day (HYBRID)

All groups participated in workshops with two workdays per week and one homework assignment. For all groups, the first workday met together as a class. The design of the course

follows principles of skill acquisition theory as set forth by Ellis (2008), which posits that following the development of declarative knowledge, students should practice with increasing levels of complexity, moving from controlled activities to activities based on more free forms of communication, receiving feedback, often from outside sources, to improve. For all groups on the first work day of each week, students were given listening practice with the sounds, information about the manner and place of articulation, information about spelling patterns for predicting sounds, controlled production activities, and guided production activities.

Both STRAT and HYBRID were also introduced to pronunciation practice strategies on the first day of each week, including focused listening, practicing with ASR (through Windows Speech Recognition or voice search on smart phones), and covert rehearsal. This strategy training was minimal. One strategy was introduced each week and this took one minute or less of class time each week. Each strategy would allow students to practice on their own outside of class. Focused listening is an activity that students can do with any audio or video recorded source. Instead of listening generally for entertainment, students listen specifically for pronunciation. As an example, students could listen to a recorded Ted Talk ([www.ted.com](http://www.ted.com)) with a printout of the transcript, provided along with many of the Ted Talks, highlighting words that they thought included the target sound. Students could then check their answers by checking online dictionaries for IPA transcriptions or by using the spelling patterns introduced in class, and re-listen for the pronunciation of those words. Covert rehearsal, another production practice strategy, involves speaking in isolation, not for the purpose of communication with another person, while monitoring pronunciation. When problems are detected, students can use prediction rules to improve their pronunciation in their practice. Although usually used while alone, in the context of a face-to-face course, covert rehearsal can be accomplished by asking all



students to practice at once, at a low volume, sometimes called “buzzing” because the combination of voices sounds like a indistinct hum. This activity allows students to monitor their own pronunciation, while also avoiding putting students on the spot and increasing language anxiety. Like Covert Rehearsal, practice with Windows Speech Recognition (WSR) allows students to practice the production of English pronunciation, but is the only strategy introduced that also gives students feedback on their pronunciation. Students can record difficult words and phrases and check the program’s dictation for accuracy. Students, for example, could test their pronunciation by dictating minimal pair words to the computer and checking what words the program was able to accurately dictate. When words are inaccurately recognized due to a pronunciation error, students could alter their pronunciation in an attempt to get the program to accurately dictate the intended word.

The groups differed on the second workday. For TRAD and STRAT, the second workday was again face-to-face, but the hybrid course moved online using technological tools. The second workday included a listening review, but focused mostly on production. For the face-to-face course this included instructor-led listening practice, focused listening with a TED talk, partner/group production work, and whole-class practice. For the hybrid this included instructor led (recorded) listening practice and focused listening with a TED talk and production practice performed with software already a part of Windows, Windows Speech Recognition (WSR) (see Appendix A for the student guide in getting started with WSR).

WSR was chosen for two main reasons: accessibility and flexibility. Many ASR-based pronunciation programs are quite expensive, limiting their accessibility. It would be unreasonable to expect students to be willing to spend hundreds of dollars for a single program, especially in the case of this short workshop. While students could be provided lab access to

work on the programs, students would be more limited in the amount of time they could work on their pronunciation. In Banafa (2008) one of the main complaints of the study was that students wanted more access to the lab to be able to work on their pronunciation. WSR, which is already installed on most PCs as part of Windows (including Windows 8, 7, and Vista), offers easier access to pronunciation work for many students. Designed primarily with document dictation in mind, WSR allows users to “command your PC with your voice-including the capability to dictate into almost any application. You can dictate documents and email and surf the Web by saying what you see” (Microsoft, 2014). Unlike many of the ASR-based systems aimed toward language learning, WSR would not be able to score student pronunciation or tell students if they pronounced a particular word “correctly.” Instead, students would need training in how to interpret the dictation so that the dictation becomes feedback for the student on their pronunciation. The main advantage of the program is easy access. Despite Macintosh’s recent growth in popularity, PCs still make up 90% of the computers sold in the world (Pachal, 2012). Students, then, are likely to have reasonably easy access to a PC and Windows, either by owning one themselves, through a friend, or through publicly available computers. WSR also allows greater levels of flexibility than many of the language learning targeted software, such as Burlington English, in which the student would choose a topic to be covered and then would have no control over the sounds worked on. With WSR, the teacher or the student can develop activities to be worked on. Students can also bring in particular words or phrases that they have struggled with. Students will be directed to monitor the dictation provided by WSR and work on correcting their pronunciation if the program was not able to correctly identify targeted sounds in the intended word.

A hybrid design was chosen for the HYBRID group to address concerns by Littlewood not to depend overly on technology. He cautioned teachers that, even with technology that can provide feedback, teachers are still needed for support and feedback. Littlewood pointed out that with technology still quite limited, work that is entirely self-access and lacking instructor input may not be adequate for students to improve or develop a sense of autonomy. Littlewood stated, “Until cost-effective ways are found of simulating the essential aspects of the human response (in particular, its creativity, and unpredictability), self-access work will be most effective when it complements other forms of learning experience within an integrated language course” (1997, p. 89). Thus, a course that integrates technology with aspects of traditional teaching may be most effective. One way of doing this is to create a hybrid course, with half of the work in a traditional face-to-face course and half of the work done with technology (online or with software). This hybrid design may also address a concern of Schwienhorst that students will only practice and experiment if they have easy to use tools and instruction that makes such experimentation meaningful (2008, p. 23). The computer-based listening and production activities for the hybrid course were managed through Moodle, an open source course management website. Moodle is hosted and supported through the English department of Iowa State and students can report problems and receive assistance with the service through the English department.

Finally, all groups were asked to submit a recorded file each week as homework. The assignment asked participants to record activities that demonstrate work in these areas. Table 2 shows a summary of the topics and activities covered by each group.

**Table 2.** Weekly Topics/Activities Covered by Group

DAY 1	TRAD	STRAT	HYBRID
Minimal Strategy Training		X	X
Instructor Led Listening	X	X	X
Articulation Information	X	X	X
Spelling Patterns	X	X	X
Controlled Production Activities	X	X	X
Guided Production Activities	X	X	X
DAY 2	TRAD	STRAT	HYBRID
Instructor Led Listening Review	X	X	X
Focused Listening with TED talks	X	X	X
F2F Production Practice	X	X	
Production Practice with ASR			X
HOMEWORK	TRAD	STRAT	HYBRID
Short Recording Covering Sounds from Week	X	X	X

### Participants

Participants for the research study were enrolled in 99L: Strategies for Listening at Iowa State University. Across the six classes of 99L included in the study, there was a total of 84 students. Of those, 71 gave informed consent. 23 students were excluded from the data because they either failed to take one of the three surveys (pre-, post-, or delayed post-survey) or missed more than one class period. There were 48 total participants included in the data (TRAD: 15, STRAT: 17, HYBRID: 16). All of the 48 participants included in the data completed at least five of the six workshop days and all of the surveys. As expected based on the large number of Chinese students at Iowa State University, the majority of participants in this study spoke Chinese as their L1 (68.75%). Korean was the second most common L1 (14.56%). Other languages represented were Malay, Marathi, Turkish, and Hindi. The average age of participants was 21.1 years. The majority of students were undergraduates (72.9%). Males slightly

outnumbered females at 56.3%. Most students had been studying English for at least 7 years (77.1%). Most of the students had been in the U.S. for less than 6 months (77.1%). The average score on the diagnostic was (64.0%). Table 3 provides demographic information broken down by group.

**Table 3.** Participant Background Information

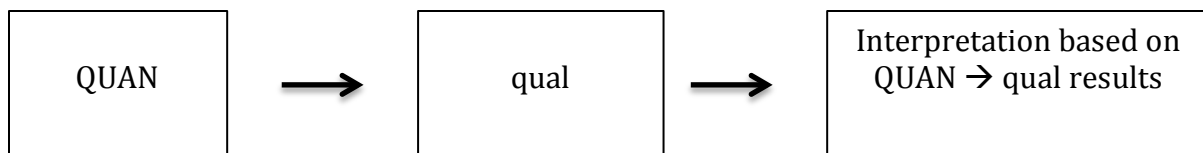
<b>Group</b>	<b>N</b>	<b>L1</b>	<b>Ave Age</b>	<b>Enroll Status</b>	<b>Gender</b>	<b>Ave (Yr) English Study</b>	<b>Ave (Mo) Lived in U.S.</b>	<b>Ave Diag</b>
<b>TRAD</b>	15	Chinese: 9 Korean: 4 Malay: 1 Marathi: 1	21.1	UG: 11 G: 4	F: 9 M: 7	7.1	8.4	64.8
<b>STRAT</b>	17	Chinese: 11 Korean: 2 Malay: 3 Turkish: 1	21.5	UG: 12 G: 5	F: 5 M: 12	7.5	14.8	65.0
<b>HYBRID</b>	16	Chinese: 13 Korean: 1 Malay: 1 Hindi: 1	20.6	UG: 12 G: 4	F: 8 M: 8	8.1	3.4	62.2

### **Methods for Evaluation**

For this study, a mixed methods approach utilizing both quantitative and qualitative measures was used to evaluate the effectiveness of the pronunciation workshops in fostering autonomy since “mixed methods research provides more comprehensive evidence for studying a research problem than either quantitative or qualitative research alone” (Creswell & Plano Clark, 2007, p. 9). This approach is often also considered more practical because it allows research to use all available methods to answer a question, instead of limiting to only quantitative or qualitative data (Creswell & Plano Clark, 2007, p. 10). Mixed methods research was particularly useful in this study because beyond knowing simply if students’ reported beliefs of autonomy have increased, a goal of this study is to understand the learners’ views of what has changed for

them and why. Nguyen (2012) proposed that, because of the complicated nature of autonomy, to measure student autonomy “rigorously” a mixed methods approach is necessary (p. 53).

In this research study, the data was mixed in an explanatory mixed methods design, a two-phased design type (Creswell & Plano Clark, 2007) in which the qualitative data was used to explain the quantitative data. For this study, because the overarching question—whether self-access work with ASR for pronunciation experimentation help foster learner autonomy compared to traditional face-to-face pronunciation courses, was basically a yes/no question with a testable hypothesis, the quantitative data played a primary role. The qualitative data supported the quantitative data, allowing deeper understanding of the issue and explaining results from the quantitative measures. Figure 1 shows the manner in which the data was mixed in order to answer the research question.



**Figure 1.** Explanatory mixed methods design (recreated Creswell & Plano-Clark 2007, p. 73)

For this study, quantitative data, collected through a pre-, post-, and delayed post-survey as well as weekly learning logs, were used to answer question 1 and 3. Qualitative data, collected through interviews, open-ended questions on the weekly learning logs, and focus groups, were used to answer questions 2 and 4. The methods used to collect data, then, included surveys, an interview, weekly learning logs during the course of the three week pronunciation workshop, and a focus group.

The research study used the following schedule:

- Week 1:** Pre-workshop survey
- Weeks 2-4:** Three week pronunciation workshop and learning logs
- Week 5:** Post-workshop survey
- Week 6:** Interview
- Week 8:** Delayed post-workshop survey
- Week 9:** Focus group

## Surveys

Surveys, which are useful for assessing attitudes and obtaining content from participants (Johnson & Turner, 2003), were used to address questions 1 and 3. To assess changes in stated beliefs of autonomy and autonomous learning behaviors, participants took three surveys, a pre-workshop survey, a post-workshop survey, and a delayed post-workshop survey. All surveys were administered through the free service, Google Forms. The pre-workshop survey (see Appendix B) contained five demographic data questions, six pronunciation learning habit questions, and fourteen Likert scale questions in which participants were asked to rate their agreement or disagreement with statements regarding their autonomy in their pronunciation learning. The post-workshop survey (Appendix C) contained the same Likert scale items as the pre-workshop survey, which allowed for comparisons of reported beliefs of autonomy before and after the workshop. The delayed post-workshop survey (Appendix D) contained the same six pronunciation learning habit questions as the pre-workshop survey. Answers allowed analysis of habits adopted in the long-term.

Because of the lack of previous work in this area, it was necessary to create a survey to address the issue of autonomy as related to pronunciation. The Likert scale questions were designed with statements that would address different features or aspects of autonomy. Based on Holec's (1981) definition of autonomy, which labeled autonomy as an ability, and Benson's

(1997) psychological version of autonomy, which labeled autonomy as a capability based on attitudes and abilities, three Likert scale items asked about feelings of capability for autonomy, such as “I am capable of improving my English pronunciation on my own.” Based on Benson’s technical version of autonomy, which contended that autonomy is dependent on strategies and tools, and Schwienhorst (2008) who emphasized autonomy as being accomplished through experimentation, three items asked students about their knowledge of strategies and tools for pronunciation experimentation and practice, such as the statement “I am aware of multiple strategies to practice my English pronunciation” and one question asked about their enjoyment of experimentation with activities in “I like trying new activities to improve my pronunciation.” Because autonomy has also been linked to experimentation, practice with the language would be seen as a positive sign of autonomy. Also because in some autonomy research, experimentation has been assessed through frequency of communication with others for practice, but because learners may be hesitant to practice their pronunciation this way due to language anxiety (MacIntyre, 2007) practice has been divided into two items one anti-autonomy item regarding communication with others (“I avoid talking with others in English because I am concerned about my pronunciation”) and one pro-autonomy items regarding practice more broadly (“I practice my pronunciation in English frequently.”). Because autonomy has been defined by Holec, Benson, and Schwienhorst as an ability to act independently, dependence on others for improvement is seen as anti-autonomous. Thus, there were three anti-autonomy items that addressed dependence on native speakers or teachers, such as “I need a teacher to help me to improve my pronunciation.” Finally, because of the links between autonomy and motivation (Deci & Ryan, 1985), two items asked students broadly about their motivation for working on their pronunciation, such as in “I want to continue improving my pronunciation.”



The study was piloted in order to make improvements. Based on the pilot study, which had nine original Likert scale items on the survey, two items were immediately identified as problematic due to unclear language. The seven retained Likert items were tested for internal consistency and reliability. For the pre-course survey the Cronbach's Alpha coefficient of the seven items was .174, which was problematic. The Cronbach's Alpha coefficient of the seven items for the post-course survey, however, was .792. George and Mallery (2003) claimed that any result above .7 is generally considered acceptable. Given the fact that autonomy is a multifaceted and complex issue (Nguyen, 2012), the result of .792 for Cronbach's Alpha coefficient is considered quite good, especially considering the limited number of participants in the pilot study (n=7). It was suspected that the phrasing of the questions relied on terminology that students may have been less familiar with at the beginning of the workshop, such as "tools" in the question "I have tools that can help me work on my pronunciation" which would account for the extremely low Cronbach's Alpha coefficient for the pre-workshop survey. The minor phrasing changes made to the questions made the questions clearer to students who may not have been accustomed to such terminology. These improvements in phrasing do seem to have helped, particularly in the pre-workshop survey. Items on the survey were broken into groups based on the content being assessed and tested again using Cronbach's Alpha. Results showed more correlation between items and improvement in survey items.

**Table 4.** Cronbach's Alpha Coefficient Results for Pre- & Post-Workshop Survey Items

	<b>Pre</b>	<b>Post</b>
Capability (n=3)	.354	.675
Experimentation (n=6)	.663	.714
Dependence (n=3)	.846	.863
Motivation (n=2)	.817	.692

## Interviews

About half of all participants in each group (TRAD: 8, STRAT: 8, HYBRID: 12) took part in an interview after the completion of the workshop and the post-workshop survey. Interviews were considered useful in this study because they allow for “unscripted, conversational data” (Gass & Mackey, 2007, p. 136). Interviews also allow for added clarity and deeper lines of questioning than surveys (Johnson & Turner, 2003). Interviews are a useful complement to survey data (Creswell, 2003), because they can fill the gaps or missing data that surveys were unable to address because of the need to keep surveys short and simple for clarity and ease of use (Johnson & Turner, 2003).

Questions in the interview elicited responses about what caused participants to change their responses from the pre- to post-surveys, what strategies and tools are now in the participants’ pronunciation learning repertoire, and how participants’ experiences with the WSR (for the participants that used WSR) affected their view of WSR as a tool for work on their pronunciation. For the complete set of questions see Appendix E.

While students were informed that their responses to the interview were only for the purposes of the research study and would not affect their grade in the course, and while students were encouraged to speak freely, it is important to note that the relationship between the researcher, who was also the instructor for some of the course sections, could have impacted the responses participants gave. Students may not have been willing to admit hating activities or failures to complete work. To address this, students that were enrolled in the researcher’s course sections were interviewed by research assistants.

### **Language learning logs**

At the end of each week, students reflected on their pronunciation work outside of the work required for class (Appendix F). They were asked to report time spent working on their pronunciation, types of activities used to work on pronunciation that were not part of the required class work, and their reactions to the work. Responses to the logs were mostly used to answer question three, which addresses differences in autonomous learning behaviors. Students were asked to report the amount of time spent on required work for the class and the amount of time spent for optional extra autonomous pronunciation learning each week. Also, students were asked for their reactions to each type of work completed, which was included in the qualitative data analysis to address changes in reactions.

### **Focus groups**

After completing the delayed post-survey, which asked about continued use of activities for language learning, about half of the participants (10) in HYBRID took part in a focus group. Focus groups, like interviews, are useful at getting in-depth information (Johnson & Turner, 2003). They also have additional benefits, though, in that participants can react off of one another. When participants are grouped, then, by their amount of use of ASR as reported on the delayed post-survey, the focus groups could be particularly useful in identifying common reasons underlying choices to continue or stop use of ASR. Additionally, participants who have stopped using ASR could be hesitant to admit to this behavior in a one-on-one interview where the interviewer is both researcher and instructor. In a group, though, participants may feel safer, be emboldened when hearing similar stories, and may be more willing to be honest and open about their beliefs (Madriz, 2000). Participants in one hybrid section were broken into two groups based on responses to the delayed post-survey, with groupings based on similar reported

amounts of continued autonomous work with WSR. Participants were asked eight questions about their use of WSR (See Appendix G).

### **Data Analysis**

To answer the first and third research question inferential statistics were used to compare the Likert scale responses on the pre-workshop survey to the post-workshop survey, the frequency scales of use of strategies, and the time reported as spent on autonomous learning.

#### **Questions 1 and 3: Quantitative**

1. Does work with ASR in a hybrid pronunciation course foster a higher self-reported belief of autonomy than traditional face-to-face instruction?
3. Do students in the hybrid course self-report more autonomous learning behaviors (more time spent or more activities used for autonomous learning)?

To test for significance, first it was necessary to clarify my hypothesis for the questions. The null hypothesis for both questions is:

- $H_0$ : There is no difference in reported autonomy between the experimental group and the control groups

Because there is some evidence that technology seems to be useful for fostering learner autonomy, I will make my alternative hypothesis for each question one tailed:

- RQ1-  $H_A$ : The hybrid experimental group will report increased changes in reported positive beliefs of autonomy than either control group
- RQ3-  $H_A$ : The hybrid experimental group will report more time spent on and more activities used for autonomous learning than either control group

The responses to the survey were averaged (flipping the numbers on the anti-autonomy items) to get an average pre- and an average post- score. Because the data from the Likert items

and scaled frequency items are ordinal level, having an “inherent order” (Romano, Kromrey, Coraggio, & Skowronek, 2006) and due to the small group sizes, non-parametric statistics were considered most appropriate. Using a Wilcoxon Signed Ranks test, the non-parametric alternative to a paired t-test (Larson-Hall, 2010), the pre- and post-autonomy scores were compared to see if any of the groups significantly improved in their stated beliefs of autonomy. Then to compare across groups, the pre-workshop score was then subtracted from the post- to get a measure of the change or difference between the scores. A Mann-Whitney U test, which is used to compare ranked responses (ordinal level) from two populations to look for consistently higher results in one population, was appropriate (Harshbarger, 1971) and was used to compare the changes in the overall autonomy scores for the three groups. Finally, to break apart each of the Likert scale items apart, the change scores (subtracting pre- from post-) were also calculated for each Likert scale item. A Kruskal-Wallis test was used to determine if the differences across groups was significant. A t-test, however, was used to compare the time spent on autonomous pronunciation work and the number of activities listed because this data is interval level, having a rank order as well as “a definite interval between the variable’s values [meaning that] values can be added and subtracted in a meaningful way” (Romano et al., 2006, p. 4).

Questions 2 and 4, however, required the use and analysis of qualitative data analysis.

#### **Questions 2 and 4: Qualitative**

2. How do students account for the changes in self-reported beliefs of autonomy?
4. How do students explain choices to continue or stop working with ASR after the course ends?

In order to analyze the qualitative data, each of the interviews and focus groups were first transcribed verbatim. Using a general inductive approach, in which “the primary mode of

analysis is the development of categories from the raw data into a model or framework that captures key themes and processes judged to be important by the researcher” (Thomas, 2003, p. 3), the interviews, open-ended questions on the language logs, and focus group responses were coded and labeled for emerging themes and ideas. As recommended by Creswell and Plano Clark (2007), to enhance validity, the researcher used a form of peer review, asking another graduate student to examine a subset of the data to also look for codes/labels or themes that the main researcher may have missed.

Table 3 provides each of the four proposed research questions, the data collection methods to answer each question, and the analysis proposed for the data.

**Table 5.** Research Questions, Methods, and Analyses

<b>Research Question</b>	<b>Data Collection Method</b>	<b>Analysis</b>
Does work with ASR in a hybrid pronunciation course foster a higher self-reported belief of autonomy than traditional face-to-face instruction?	Likert scale items on pre- and post-workshop survey	Wilcoxon Signed Ranks to compare pre-post for each group, Kruskal-Wallis to compare change scores on Likert scale items
If so, how do students account for the changes in self-reported beliefs of autonomy?	Post-workshop interview	General Inductive Approach
Do students in the hybrid course self-report more autonomous learning behaviors (more time spent or more activities used for autonomous learning)?	Weekly language learning logs and delayed post-course survey	Kruskal-Wallis for time and activities reported
How do students explain choices to continue or stop working with ASR after the course ends?	Post-workshop interview and Focus group	General Inductive Approach

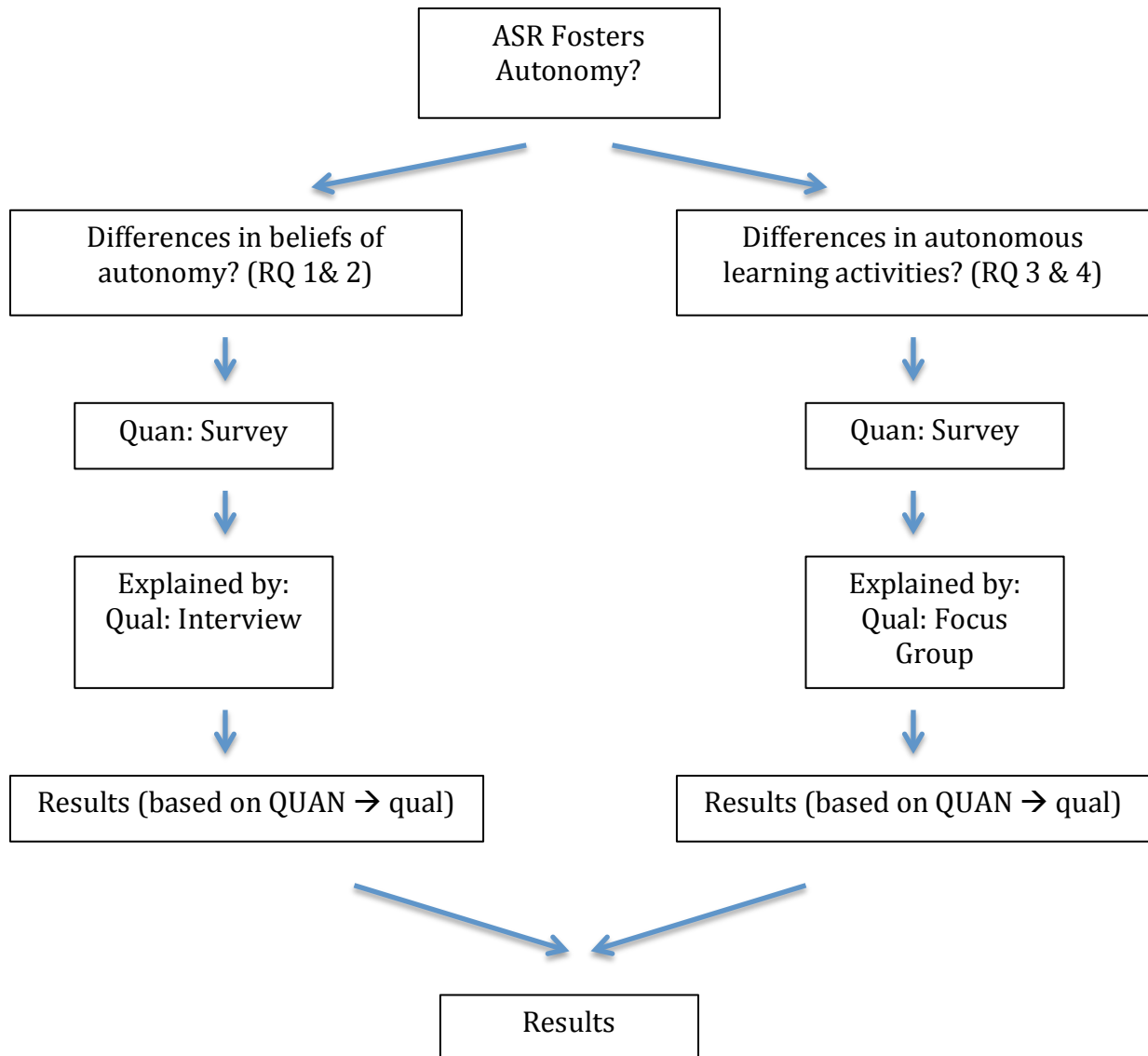
### **Validity**

Validity of the research findings was assured in two basic ways. First, each of the data collection techniques used were checked for validity. As mentioned in the survey section, the

surveys were developed to maximize content validity drawing from research and theory to create questions that would best capture the many facets of autonomy. The surveys were piloted and steps were taken to improve the survey based on those results. Results from the survey were then checked for reliability through Cronbach's Alpha. For the qualitative methods, as recommended by Creswell and Plano Clark (2007), the researcher used a form of peer review, asking another graduate student to examine a subset of the data to also look for codes/labels or themes that the main researcher may have missed. Also, disconfirming evidence in the data were included and reported, to give a more thorough image of the findings (p. 135). These methods helped ensure that the specific data collected from each method is reliable and valid.

The second step to ensuring validity of the findings was triangulation, which is broadly defined as "the combinations and comparisons of multiple data sources, data collection and analysis procedures, research methods, and/or inferences that occur at the end of the study" (Tashakkori & Teddlie, 2003, p. 674), allowing comparison across the findings of each of the methods to support the overall conclusions. The great advantage of mixed methods designs is that it is the convergence of results from two or more methods that heightens confidence that the results are valid and not a product of a problematic methodology (Bouchard, 1976; Jick, 1979).

The results to the overarching question, then, were addressed by triangulation in the following manner (as shown in Figure 2):



**Figure 2.** Explanatory design for overarching research question



## CHAPTER 4: RESULTS

This chapter discusses the results of the research study in detail. Because research questions 1 and 2 focus on beliefs of autonomy and questions 3 and 4 focus on autonomous learning behaviors, there are two major results sections. In each section, the quantitative data is presented first followed by explanations from the qualitative data.

### Beliefs of Autonomy

In order to answer research questions 1 and 2, students' beliefs of autonomy were examined through pre- and post-workshop surveys with Likert scale items as well as a post-workshop interview.

1. Does instruction incorporating ASR as a pronunciation learning strategy foster a higher self-reported belief of autonomy than traditional face-to-face instruction?
2. How do students account for changes in self-reported beliefs of autonomy?

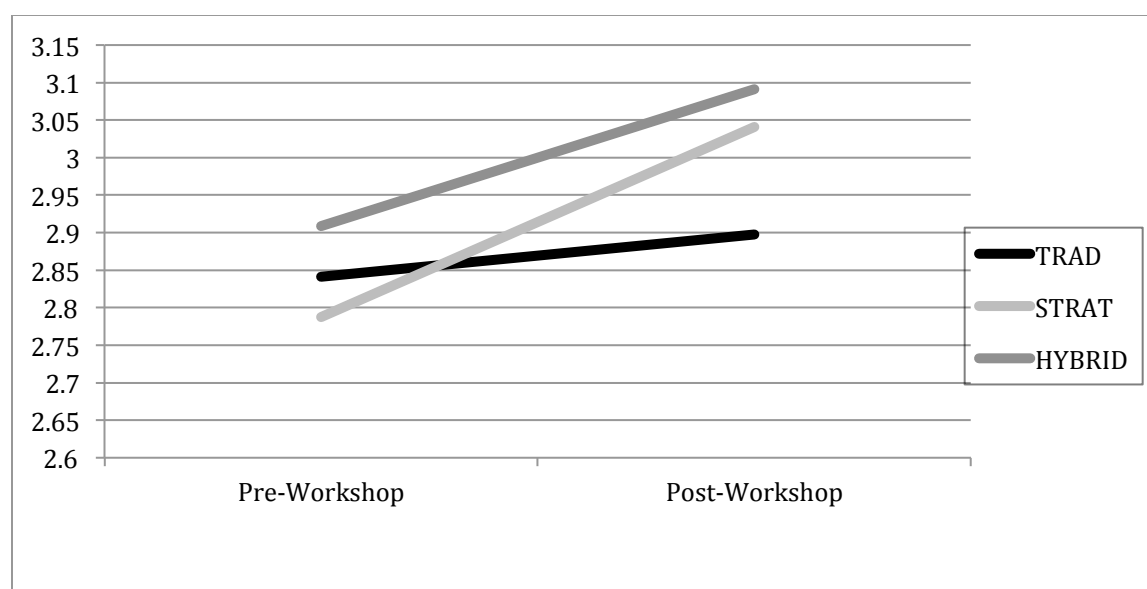
The results from the pre- and post-workshop survey Likert scale items on belief of autonomy were first analyzed by creating an autonomy score for each participant by averaging the scores given on each separate Likert scale item. These scores were then tested for improvement by Wilcoxon Signed Ranks which allowed a pre-/post-survey comparison. Results showed that while both of the experimental groups improved in their beliefs of autonomy, the control group did not. The average autonomy belief improvement of .253 for STRAT and .183 for HYBRID were statistically significant ( $p=.006$  for STRAT and  $p=.013$  for HYBRID), while the improvement of .056 for TRAD was not statistically significant ( $p=.727$ ). Effect sizes were calculated using  $r=z/\sqrt{N}$ , where  $N$  represents all observations. The effect size for STRAT's improvement was 0.51, while the effect size for HYBRID's improvement was 0.44. To check if there were any statistically significant differences between STRAT and HYBRID, Mann-

Whitney U was used on the average change scores (subtracting the average pre- from the average post-survey autonomy score) for each group. The difference between STRAT and HYBRID was not statistically significant ( $p=.465$ ). Table 6 shows the average pre- and post-workshop average autonomy scores for each group, along with SD and statistical significance from pre- to post-survey based on the Wilcoxon Signed Ranks. The highest level of autonomy possible given the survey scale was a five, while the lowest possible level was a zero.

**Table 6.** Average Autonomy Scores for Pre- and Post-Survey and Significance

Group	Pre Aut. Ave	SD Pre	Post Aut. Ave	SD Post	Sign.
<b>TRAD</b>	2.841	0.571	2.897	0.631	.727
<b>STRAT</b>	2.787	0.360	3.041	0.345	<b>.006</b>
<b>HYBRID</b>	2.909	0.324	3.091	0.303	<b>.013</b>

Figure 3 shows graphically the change in average autonomy belief for all groups from the pre- to post-survey.



**Figure 3.** Changes in beliefs of autonomy from pre- to post-workshop survey

In order to look at changes in beliefs for each Likert scale item separately, Kruskal-Wallis was used to analyze the changes from pre- to post-survey on each Likert scale item across groups. Results indicated that no single item on the survey was statistically significant across groups (p values ranged from .307 to .907). Table 7 shows the average response score for each group on each Likert scale item (for a full table that includes Standard Deviations, please see Appendix H).

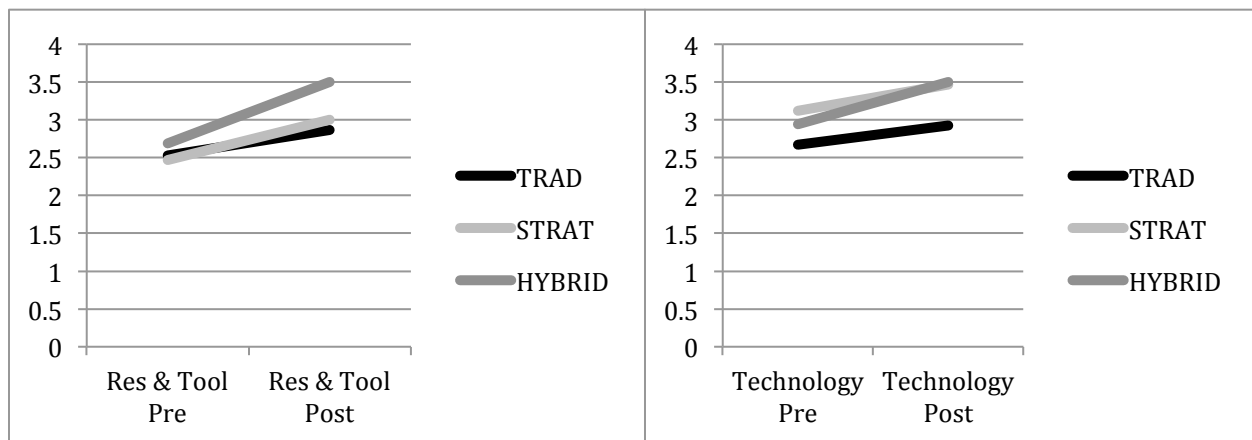
**Table 7.** Average Response Score for Each Likert Scale Item by Group

<b>Likert Scale Item</b>	<b>TRAD Pre</b>	<b>TRAD Post</b>	<b>STRAT Pre</b>	<b>STRAT Post</b>	<b>HYBRID Pre</b>	<b>HYBRID Post</b>
I avoid talking with others in English because I am concerned about my pronunciation.	1.93	1.73	2.00	1.41	1.25	1.25
I care about my pronunciation in English.	3.73	3.67	4.29	4.35	3.75	4.00
I want to continue improving my pronunciation.	4.27	4.07	4.47	4.53	4.38	3.50
I practice my pronunciation in English frequently.	3.07	3.27	2.82	3.41	3.50	4.13
It is possible to improve my pronunciation.	3.80	3.87	3.94	4.06	4.19	4.44
I need to hear a native speaker to know how to pronounce a word correctly.	3.73	3.87	4.18	4.18	4.38	4.56
I need a native speaker to correct me on my pronunciation to improve	3.53	3.60	4.18	4.18	4.25	4.44
I need a teacher to help me to improve my pronunciation	3.73	3.80	4.06	4.00	4.19	4.38
I am aware of multiple strategies to practice my English pronunciation.	3.07	3.33	3.29	3.65	3.56	3.50
I am capable of successfully practicing my English pronunciation on my own.	2.80	3.07	2.82	3.12	3.06	3.31
I have resources and tools that can help me work on my pronunciation.	2.53	2.87	2.47	3.00	2.69	3.50
I can use technology to help me with my pronunciation.	2.67	2.93	3.12	3.47	2.94	3.50
I like trying new activities to improve my pronunciation.	3.93	3.60	3.41	3.71	3.81	4.06

Although no single Likert scale item tested showed statistically significant results, in the interviews, particularly in the experimental groups, students pointed to the changes in their tools and resources as the main change for their changes in beliefs of autonomy regarding their pronunciation practice and improvement. The next section explores students' beliefs of autonomy, broken down by different aspects of autonomy addressed, beginning with changes to beliefs as shown through survey items and following up with explanations provided through the interviews. Because students singled out changes in tools and resources as important, the first section addressed is issues relating to experimentation.

### Experimentation

Six of the Likert scale items asked about experimentation (either with the language or with language learning resources). While all groups improved in the belief that they had resources and skills to practice their pronunciation and that they could use technology to help them with their pronunciation improvement, the hybrid instruction group made greater gains in this arena. Figure 4 shows a graph for each statement by group.



**Figure 4.** Changes in responses to “I have resources and tools that can help me work on my pronunciation,” and, “I can use technology to help me with my pronunciation” by group

When asked in the interviews about changes on these items HYBRID talked about Windows Speech Recognition (WSR) as a useful tool. For example, in response to the question, “On this item ‘I have resources and tools that can help me work on my pronunciation’ you changed your response from \_\_\_\_\_ to \_\_\_\_\_. What caused that change?” seven of the twelve HYBRID members interviewed pointed out WSR as the reason they changed their answer in the post-survey.

HYBRID-1: Before I think I don’t know pronunciation have a software to improve, but after that I found that like Siri on the iPhone and Windows software, the speech software.

HYBRID-10: Um yeah I strongly agree when I mean during the workshop we have like using the Windows Speech Recognition.... When I’m speaking different like I’m using my phone my phone can recognize what I’m trying to say

Later in the interviews, four others indicated that ASR was a useful tool for improving their pronunciation. In all, 11 of the 12 HYBRID members indicated that ASR was a useful tool for improving their pronunciation.

Six HYBRID members liked WSR. One student (HYBRID-1) said, “The software is so good and it’s very useful...easy to use...”. Five others found other similar technology that they liked better. Siri, Google Voice Search, and Dragon Dictate were other programs mentioned as better alternatives to WSR. HYBRID-7 said, “Actually, I HATE [WSR], I mean WSR...Sometimes I pronounce, I read some words that people can very quickly understand but this program is stupid. ...I dunno the name, Dragon Dictation? I think this is very helpful.” Only one student that used WSR did not like the program and did not find an alternative that they liked better. She (HYBRID-8) said, “This program cannot record my voice and my pronunciation

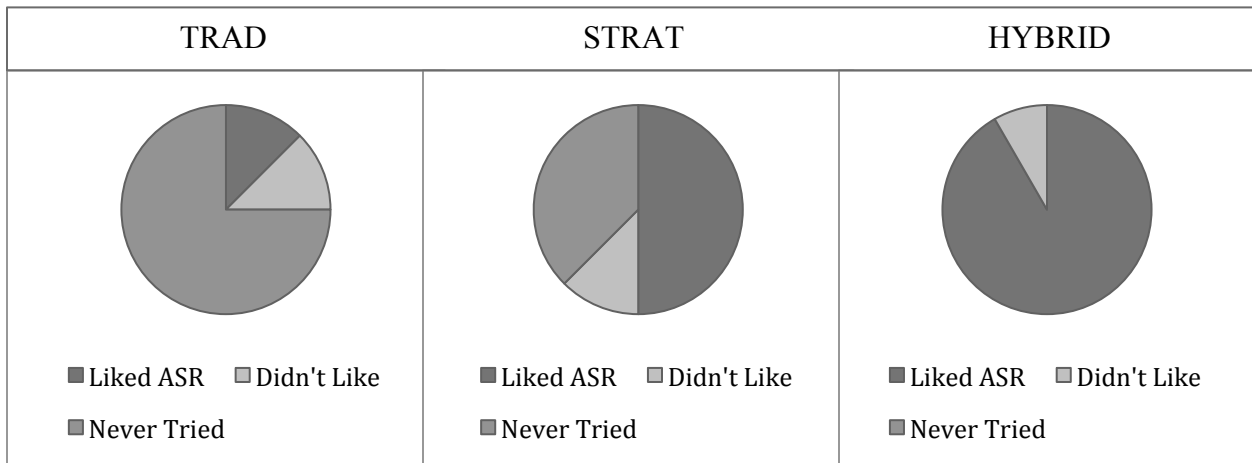
right. But so uh I think the technical device is not very useful and I think it is not quite the clear or right system to practice and improve my pronunciation.”

Figure 4 also shows, however, that STRAT made noticeable gains in resources and tools. When asked about this in the interview, a surprisingly large number of STRAT members reported having tried ASR despite it not being required for the class. Four members (50 % of STRAT interviewed) used a form of ASR and found it useful. Three pointed specifically to ASR as the reason they changed their response to the post-survey question about resources and tools. STRAT-1, who used Dragon Dictate, said, “Yeah it’s helpful and kinda cool...because if I pronounce incorrectly, it is the wrong pronunciation, they not come out as the words...I feel free with using that tool, because if I keep the wrong pronunciation it will be fine because nobody knows...I can practice whenever I want without any embarrassment.” One student from the STRAT group did try ASR and found it useless (STRAT-8). She said, “Ok first I use it, it can be very helpful because our teacher recommended it and I believe my teacher. Then I use it. The results turns I can be good; I act very good in this technology. Maybe I feel very confident so I think I don’t need this technology.” Three members of this group decided not to try the technology. One student (STRAT-11) said, “I think she introduce it to me...But I didn’t try it.”

Only two of the control group (who were not introduced to ASR in class) had tried using ASR for pronunciation work. One of those students liked it and found it useful, while the other did not find it useful. TRAD-1 said, “I think about my pronunciation because when I speak to Siri, actually Siri writes back what I have spoken, so I know oh this part of my pronunciation I got wrong because word is written in Siri so I know that I got that part wrong.” TRAD-15, however, stated that after trying the program she gave up on it. She said, “Yeah yeah maybe you

found this word is not your word. Maybe your pronounce is wrong... but um most time computer cannot recognize my speaking so I give up.”

Figure 5 shows the different reactions to ASR by each group. One noticeable feature of the graphs is that while in each group there was a single user that reported not liking ASR, the number of students reporting having tried ASR differs greatly. This also leads to a different relationship within the groups of students that did try ASR. For example, in TRAD one student liked ASR while one did not. Therefore, one half of students that tried ASR in TRAD disliked ASR, while only 20% disliked ASR from STRAT, and, further, only 8.3% disliked ASR in HYBRID.



**Figure 5.** Reactions to ASR use by group

One explanation that emerged from the HYBRID group was that the first time trying the program was incredibly frustrating. Students often described the first attempt as driving them crazy. Three students explained their reactions to the first try with WSR as the following:

HYBRID- 3: Like the WSR the first time I need to repeat several times a word and that made me crazy!...

HYBRID-5: Yeah from the very beginning of that the program made me crazy. No matter how many times I say the single word it comes out another word.

HYBRID-6: Actually in the first time it doesn't work very well.

But many of these students, through repeated attempts with the program, discovered ways to use the program more successfully and began to appreciate the program. HYBRID-3 and HYBRID-6 described the coping strategies that they developed to make word with the program more successful.

HYBRID-3: But if you use in a sentence it can record the correct words. So I used that method to record the word I want....

HYBRID- 6: So I have to check the dictionaries and listen to the dictionary recording many times so I can pronounce it right so the machine can recognize my voice. Yeah but after that I think maybe it's a struggle at first, but it did improve my pronunciation

Other students discovered that switching to other programs made them feel more comfortable.

HYBRID-7: Dragon Dictation? I think this is very helpful.

HYBRID-10: Google, like Google voice search...WSR it's kind of good but not totally really helpful but it's help me a little bit with my pronunciation, but the problem is when I speak we have these activities which are called word pairs which are the similar words with the slightly different sounds but the WSR can't recognize what I'm trying to say, but if I say a long sentence [it is better]

These students, through practice with WSR several times for required work, had the opportunity to fully explore the potential of the program. On the other hand, the two members of the other groups that did not like ASR mentioned only trying it once and giving up. Because the first time was by far the most frustrating, these students may have had different reactions if they had been pushed to use the program a bit more.



Students primarily liked using ASR because it provided feedback. Ten of the 28 students interviewed (36%) specifically brought up that they could not hear when they made pronunciation mistakes when speaking. The following are examples, one from each group:

TRAD-3: Because sometimes I made some mistakes but I can't notice.

STRAT- 2: Sometimes when I say a word I think to myself it is right but in fact I am wrong

HYBRID-11: Maybe I try [to pronounce it] but some there will still some mistakes I made it, I didn't know so it's some disadvantage of my of practice myself

This lack of mistake recognition in one's own speech led students to devalue the pronunciation learning strategy, covert rehearsal. For example, student E-4 said, "I think during the covert rehearsal this is the time I tried to speak in the correct way the most, but I can't get feedback. So when I, so I think this is a problem. Feedback is a problem in the covert rehearsal." Thus, many students appreciated the opportunity to get feedback from ASR.

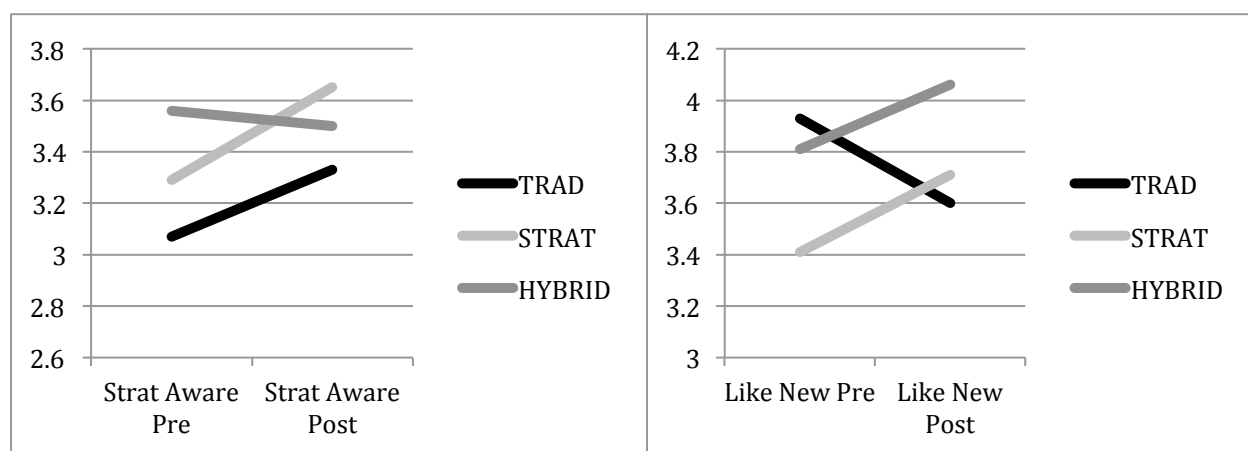
STRAT- 1: Yeah it's helpful and kinda cool...because if I pronounce incorrectly, it is the wrong pronunciation, they not come out as the words. So I can fix several times and then I can find which one is right.

STRAT-9: It's not bad cause I just, you know, I just use this way and, you know, I want to improve that so I just use this way to check my pronunciation.

HYBRID-9: Yeah I think it's a really good software because when I speak to it if I didn't pronounce very well it will make mistake so I need to revise myself.

HYBRID-11: (I: so what are the advantages of WSR?) It can give feedback. I say it, it can give me the information I said.

For HYBRID, the incorporation of ASR as a strategy for practice (as well as the strategy training received on focused listening and covert rehearsal) did not, however, translate into the belief that students were more aware of strategies for practicing their pronunciation. Figure 6 shows that while TRAD and STRAT felt that they were more aware of strategies to practice their pronunciation after the pronunciation workshop, HYBRID actually declined slightly in this belief.



**Figure 6.** Changes in responses to “I am aware of multiple strategies to practice my English pronunciation,” and, “I like trying new activities to improve my pronunciation” by group

A clear reason for this change did not emerge from the interviews, but two students indicated that they may have changed and restricted their definition of pronunciation learning strategies over the course of the pronunciation workshop. Also, this realization that there are strategies that allowed them to focus much more on pronunciation may have led students to want more of the specific strategies. HYBRID-5 and HYBRID-8 explained the changes in the response to the survey question about awareness of multiple strategies by stating the following:

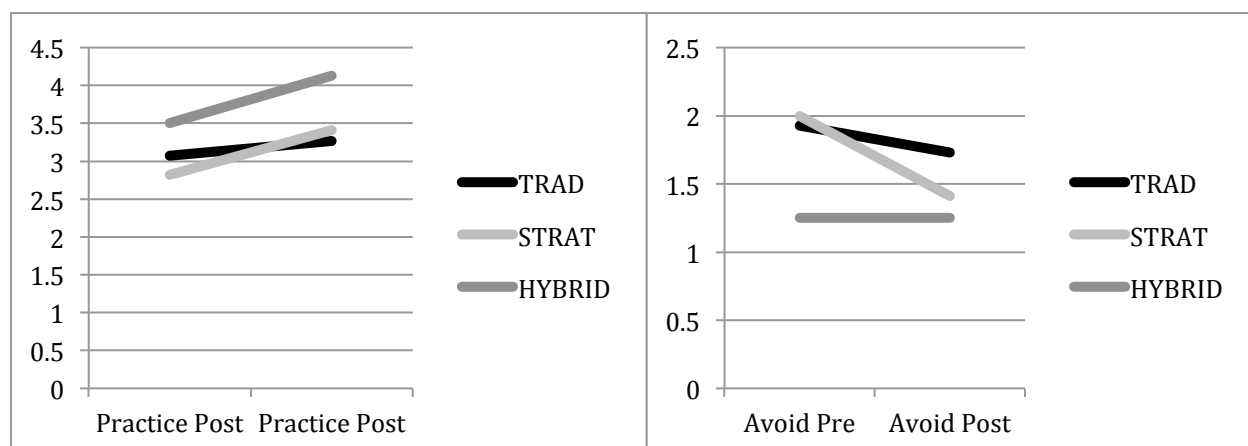
HYBRID-5: Yeah you know the most, the problem now I’m aware of it, from the very beginning I thought I could use the- I could watch the English movie or talk to someone,

but I was doing this recently....I mean recently because before I started I already know some, but from then to now I think I need some more new strategies for me.

HYBRID-8: because even though I always try to improve my pronunciation, but I'm not sure my strategies um are right so I want to take the word, the details, and more specific strategies to correct my pronunciation

Figure 6 also shows that, while STRAT and HYBRID grew to like trying new activities to practice pronunciation more through the period of the pronunciation workshop, TRAD grew to like new activities less. Given that TRAD and STRAT had very similar instruction methods (with the only difference being that STRAT received the minimal strategy training), there was no reason to expect such a different reaction. No answer emerged as an explanation from the interviews.

Students generally moved in positive directions (See Figure 7), though, regarding their choices to experiment with the language. All groups reported higher agreement with the statement, "I practice my pronunciation in English frequently," at the end of the workshop. It is noticeable, however, that TRAD made fewer gains on this item. Because these students were not trained in strategies, they had no new ways to practice and still felt a bit lost about how to do so. One student, TRAD-15, pointed out that she still didn't know how to practice her pronunciation even after the workshop because she was given no training in strategies, stating, "I still don't know how to improve my pronounce...yeah besides e-dictionary I don't know which tool can help me fix my pronounce." For students in STRAT and HYBRID, however, when they mentioned not knowing how to practice it was always in response to how they practiced before the workshop. For example, STRAT-11 said, "I have no idea to improve my pronunciation previously."



**Figure 7.** Changes in responses to “I practice my pronunciation in English frequently,” and, “I avoid talking with others in English because I am concerned about my pronunciation” by group

Students in TRAD and STRAT also made gains in beliefs regarding their avoidance of talking in English (please note that for this item lower agreement to the statement or lower scores actually indicate higher autonomy). Members from all groups explained in the interviews that they had felt anxiety when talking to others in English.

TRAD-14: Actually uh my pronunciation is not good so when I talk with others a little nervous and I’m very stressed

STRAT-3: I feel nervous all of the time, but I think I will become better

HYBRID-10 like um just not that I told you but the my club meetings so most of the members are native-are Americans so only like two international students including me so I was like freaking out at first meeting...intimidating. I’m trying to like-I understand what they’re saying but when I want to, yeah when I want to talk with them it’s like a (big?) you know

Many members, though, indicated that they had gained confidence in their pronunciation through the workshop that would facilitate conversation in English, explaining why they would be more likely to engage in conversations in English after the workshop. Six students (TRAD: 2,

STRAT: 2, and HYBRID: 2) mentioned an increase in confidence. Three examples are included below:

TRAD-1: I dunno maybe because of that workshop is actually increase my self-confidence so I think maybe because of that I like to speak English with Native Speaker...At first when I come here I didn't even attend any pronunciation workshop so when I speak to native speaker I like I speak very like energetic but they don't understand what I'm talking, maybe because they don't understand my pronunciation. But after the pronunciation workshop class when I speak to them I dunno it suddenly just like they understand what I'm talking about.

STRAT-3: Before this I'm not really confident to speak with native American because I'm afraid that if I pronounce it wrong. But maybe after this course I have more confidence.

HYBRID-10: Um ah [WSR] makes me more comfortable to talk to the others with English so I want to talk more and uh maybe it's because my pronunciation is a little bit stronger than before

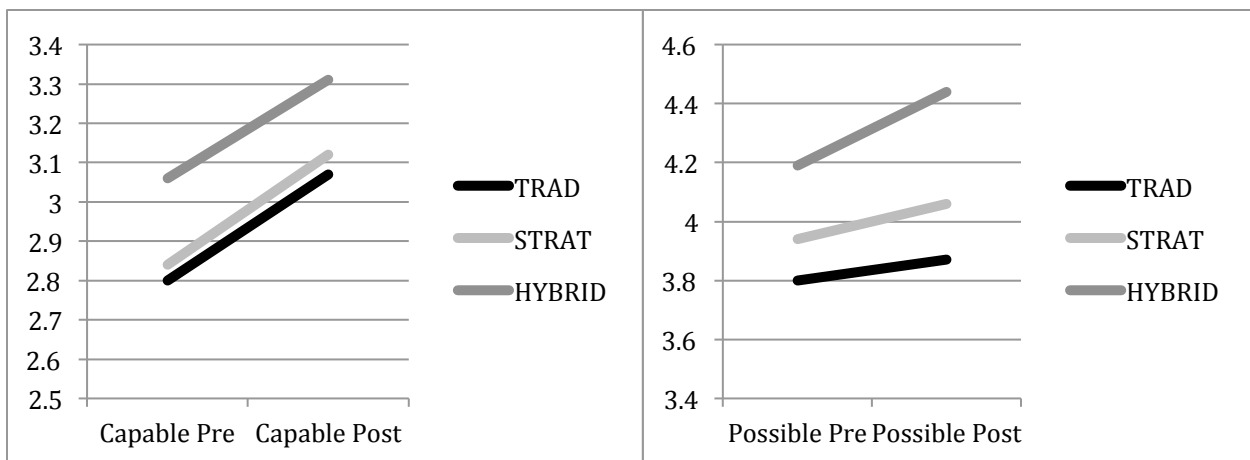
But Figure 7 shows that HYBRID did not make substantial changes in the amount that they avoided talking with others in English. Perhaps part of this is because ASR has provided another outlet for practice. ASR allowed students to avoid the embarrassment they felt when they made mistakes with other people. ASR also allowed students to focus on pronunciation more than when they were focused on creating meaning with another person in conversation. Although HYBRID members hinted at some of these ideas, it was actually STRAT members that stated the benefits of ASR over talking with others most clearly.

STRAT-1: I feel free with using that tool, because if I keep the wrong pronunciation it will be fine because nobody knows. I think that a good point of that tool is I can practice myself whenever I want. ... I can practice whenever I want without any embarrassment.

STRAT-9: So you know when we talk with other people we cannot focus on our pronunciation because we need to finish the whole sentence and make other people understand what you said for the meaning, but they don't want to point out your pronunciation is not very good. But if we use that program we can, you know, pay more attention to our pronunciation.

### Capability

The new resources and new confidence to speak with others were often also brought up in explanations to questions about changes in beliefs of capability. Two Likert items addressed capability. All groups of students showed improvement regarding capability to improve pronunciation on their own and potential to improve pronunciation overall.



**Figure 8.** Changes in responses to “I am capable of successfully practicing my pronunciation in English on my own,” and, “It is possible to improve my pronunciation in English” by group

It is interesting to note that in terms of capability, all groups, including TRAD, made similar improvements in the beliefs of their capability. While students in STRAT and HYBRID

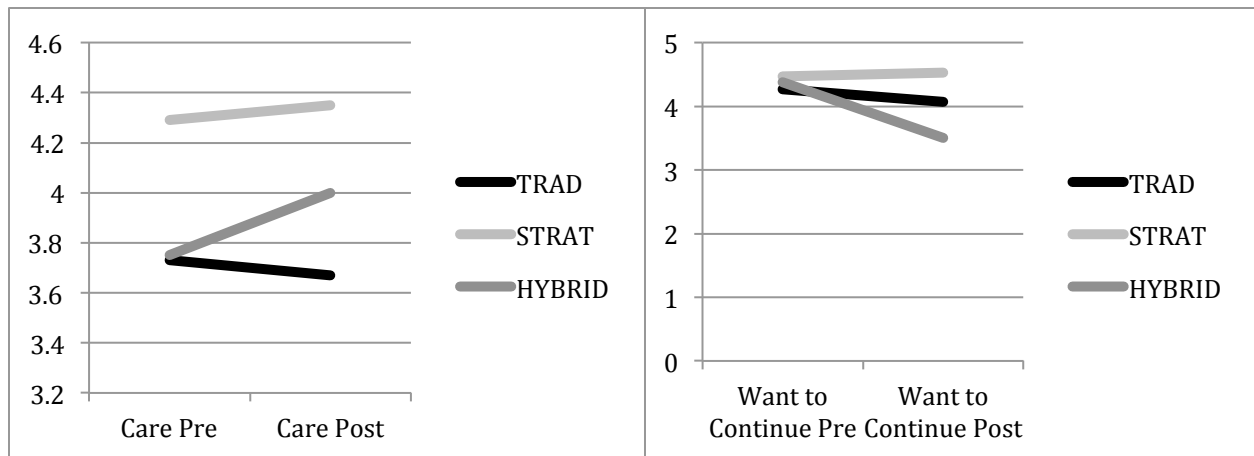
largely pointed to the new resources and tools, ASR, members of TRAD pointed to the idea that they had already improved as proof that they could improve. These students also pointed to the spelling patterns of English and information about mouth shape and movement as useful for their practice on their own. Members of TRAD stated:

TRAD-1: “I dunno maybe because of that workshop is actually increase my self-confidence so I think maybe because of that I like to speak English with Native Speaker...At first when I come here I didn’t even attend any pronunciation workshop so when I speak to native speaker I like I speak very like energetic but they don’t understand what I’m talking maybe because they don’t understand my pronunciation. But after the pronunciation workshop class when I speak to them I dunno it suddenly just like they understand what I’m talking about

TRAD-11: Like before the workshop we don’t have the tools to correct our pronunciation so the only thing way we can compare ourselves to the right pronunciation is like through the way of communication with another, but we grabbed the knowledge of how to pronounce the mouth shape to pronounce and the main feature that each [vowel] has. We can just figure them out by ourselves sometimes.

## **Motivation**

The two Likert scale items for motivation generated an interesting set of responses. The only group that improved on both of these measures was STRAT. While HYBRID made large improvements in the amount that they cared about their pronunciation, they reported wanting to continue improving less after the workshop than at the time of the pre-workshop survey. TRAD grew less motivated on both measures.



**Figure 9.** Changes in responses to “I care about my pronunciation in English,” and, “I want to continue improving my pronunciation” by group

One student from STRAT (4) summarized the group’s positive changes in motivation by stating, “Before this class I didn’t really care about my pronunciation and I started to work on my pronunciation after this course.” No student specifically mentioned wanting to stop working on pronunciation in the interviews or focus groups, although several members of HYBRID did mention that they planned to discontinue the use of WSR due to issues of convenience. This drawback of WSR is discussed further in the section on autonomous learning behaviors.

Despite the apparent lowering of motivation in Figure 6 for TRAD in both measures, and HYBRID on the measure of desire to continue working on pronunciation, comments from the workshop indicated a generally positive change in motivation.

Members from all groups (TRAD: 3, STRAT: 4, HYBRID: 6) noted that the pronunciation workshop heightened their awareness of their pronunciation. Many of the students did not realize that they had segmental errors in their pronunciation before the workshop and through the course of the workshop realized areas where they could improve their pronunciation.

TRAD-15: In class I found my pronounce has a lot of problems so I think it is time to fix it.



STRAT- 8: Yeah sometimes other American students they cannot listen to me carefully I don't know if my voice not uh high or my pronunciation is a problem so after this workshop I know I've made some several mistakes that maybe other people cannot understand what I'm saying so yeah. I learned a lot.

HYBRID-6: Because I found there are lots of words that I read wrong before I take this workshop so after I take this I recognize that I should pronounce more correctly.

Also, members from all groups (TRAD: 3, STRAT: 3, HYBRID: 2) indicated that the course was too short and that they would have liked it to last longer.

TRAD-1: C1-1 I really hope we that we can do more than 3 weeks for next coming students

TRAD-3: Too short, yeah only three weeks. Yeah I think we still have some words to need to practice.

STRAT-2: I think the teacher will help me to improve some pronunciation but the course is short so she couldn't help us to correct every pronunciation

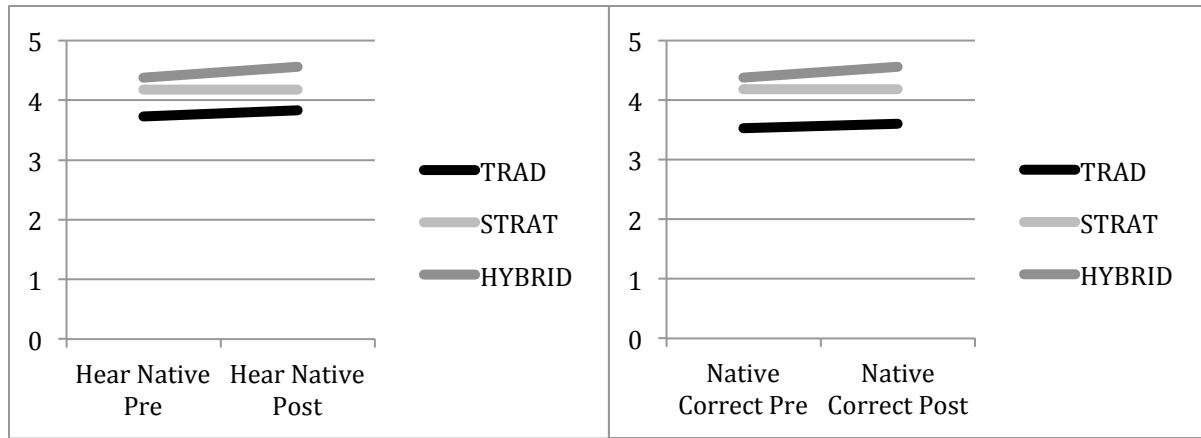
HYBRID-10: but if the workshop have a longer period than three weeks because it's just like too short I like grab everything from the workshop so it's like sad actually

These two comment types, however, hint at greater motivation being developed through the workshop for all groups, so it is not clear if there were other factors that negatively affected motivation for some groups.

## **Dependence**

Three items on the Likert scale survey asked about dependence. Higher levels of agreement (higher scores) on all three dependence items would indicate lower autonomy. The results show that the pronunciation workshop had a very limited impact on students' dependence

on native speakers as resources, but that for TRAD and HYBRID students became slightly more dependent on native speakers.



**Figure 10.** Changes in responses to “I need to hear a native speaker to know how to pronounce a word correctly,” and, “I need a native speaker to correct me on my pronunciation to improve” by group

Students explained that native speakers are still useful resources for improving their pronunciation and are still logical resources for help with their pronunciation. HYBRID-2 and HYBRID-7 explained that they still like to have help from native speakers, saying:

HYBRID-2: The native person I talk to them and I can follow them and notice uh maybe some new words I didn’t notice and I found out they say this way but I say that way. It is wrong. It is different. I can correct and I can follow them and now it’s mine.

HYBRID-7: I don’t think I need very many specific practices about English, just need someone sometimes to correct me.

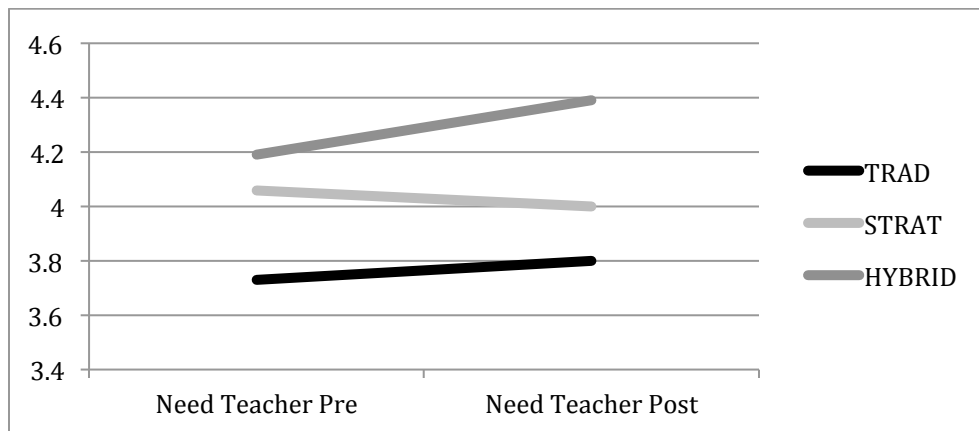
Some students pointed out that due to issues of accuracy in WSR or with non-native speakers of English, these students preferred feedback from native speakers of English. Three students explained with the following:

TRAD-1: When a non-native teacher speaker talks to me I hear their pronunciation is a little bit different than you guys so I think I better to learn English with a native speaker, to learn pronunciation.

TRAD-4: Even the Korean who speaks English very well is slightly different with the Americans so I didn't know that before taking the workshop when I learned from you I just noticed that it is necessary to learn pronunciation from the foreigners

HYBRID-8: I don't have enough time to practice my pronunciation but I always ask my roommate because my roommates are Americans so they are very helpful to fix my pronunciation... I think this is a better way better than other electronic.

Similarly, students in TRAD and HYBRID also developed higher dependence on teachers. Students in STRAT, however, slightly decreased in feelings of dependence on teachers, a positive signal of learner autonomy. Figure 11 shows changes in dependence on teachers for each group.



**Figure 11.** Changes in response to "I need a teacher to help me to improve my pronunciation" by group

Students from all groups indicated that the teacher is a useful resource (TRAD: 1, STRAT: 4, HYBRID: 8) that can help them improve. Teachers were mentioned as useful primarily because they gave helpful feedback and because they forced students to do useful work

that they might have otherwise avoided. Teachers were also mentioned as being more efficient and providing resources and strategies for improvement outside of class. STRAT-11 and HYBRID-1 explained this stating:

STRAT-11: (I: Why do you believe you have to have a teacher?) because my teacher can teach me some skills to improve my pronunciation

HYBRID-1: When I do this I think a teacher is an efficient method to improve but if I don't have a teacher I can also find a way to improve my pronunciation but maybe that is not much efficient...the teacher can offer you a method and the teacher know according to your pronunciation, they will know what's your short-where you need to improve.

Even for students of HYBRID that had worked with ASR and knew its potential for giving feedback mentioned the teacher provided feedback as a major reason to need the teacher. Two students stated:

HYBRID-7: Because I think in this English environment I can practice everyday and everyday, every American can be my teacher, but I realized that they will not just point out some problems I make so I think I need a real teacher to do that

HYBRID-8: the instructor feedback is very helpful yes definitely helpful because I she uh always check my pronunciation recording and she mentions which one if the wrong so yes I can fix it

Three students also mentioned that a teacher is useful because they push you to do work that they would normally not make time for on their own.

STRAT-10: Yeah without the class I think uh if I do not listen any pronunciation class I don't do um requirement

HYBRID-6: Yes, but without the teacher maybe I just want to, but there is no- you know somebody make you do something you will do it, but nobody asks you to you may think- you may want to do, but several weeks later you will forget it

HYBRID-7: teacher can give me assignment, specific assignment, not just talk to someone. A teacher can force me to do some homework or stuff

The strongest need for a teacher was reported from TRAD, the group that received no strategy training. TRAD-15 said, “Because you can help me fix my pronounce face-to-face. You can listen to me, my pronunciation. You have experience. You can help me fix it, how to use tongue, how to use another muscle in face.” In this sentence she was talking to the instructor of the workshop and was showing rather severe dependence on having an instructor. In the interview, she later mentioned hoping to be able to email the instructor for future assistance with pronunciation after the workshop was over. On the other hand, the student that made the strongest claims of lack of dependence came from HYBRID. HYBRID-5 stated, “[Before the workshop] I think I need some formal teachers or someone who is more experienced, who can let me do more better, but as the time continued I practiced so many times. I found my pronunciation improve a lot. I think it’s not necessary to have a teacher now.”

Although both experimental groups significantly improved in beliefs of autonomy, while TRAD did not, results from the self-reports of autonomous learning behaviors show some differences between STRAT and HYBRID.

### **Autonomous Learning Behaviors**

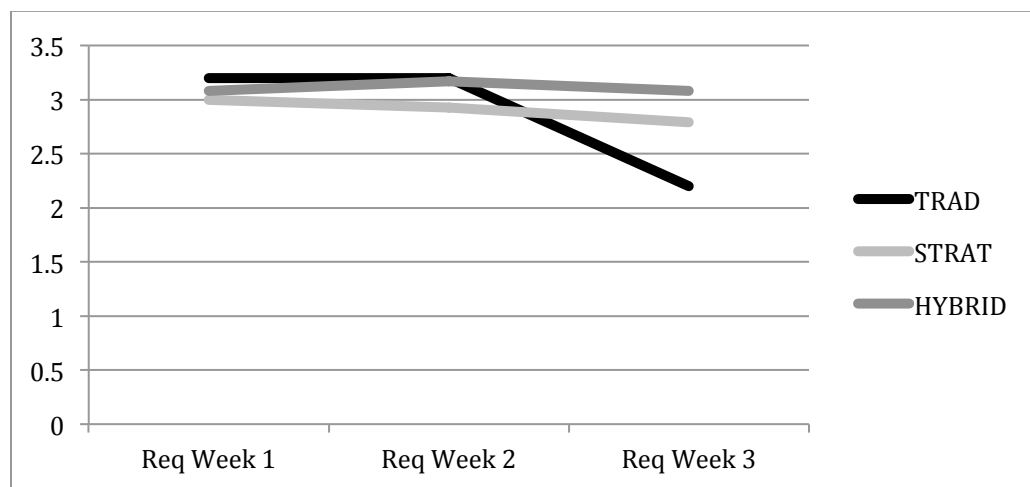
In order to answer research questions 3 and 4, students’ autonomous learning behaviors were examined through language learning logs, delayed post-workshop survey with questions

about time and activities used for pronunciation practice, post-workshop interview, and post-workshop focus group.

3. Do students introduced to ASR report more autonomous learning behaviors (more time spent or more activities used for autonomous learning)?
4. How do students explain choices to continue or stop working with ASR after the course ends?

### During the workshop

Each week, during the pronunciation workshop, students were asked about the amount of time spent on required work for the workshop (including time spent in class, for online hybrid days for HYBRID, and for homework) and elective time spent working on their pronunciation (time spent working autonomously.) Of the 48 participants included in the research study, only 36 (TRAD: 10, STRAT: 14, HYBRID: 12) submitted all three language learning logs and are included in the following analysis. Figure 12 shows time spent on required activities for class in hours by each group for each week of the pronunciation workshop.



**Figure 12.** Time spent on required activities for the pronunciation workshop for each week by group

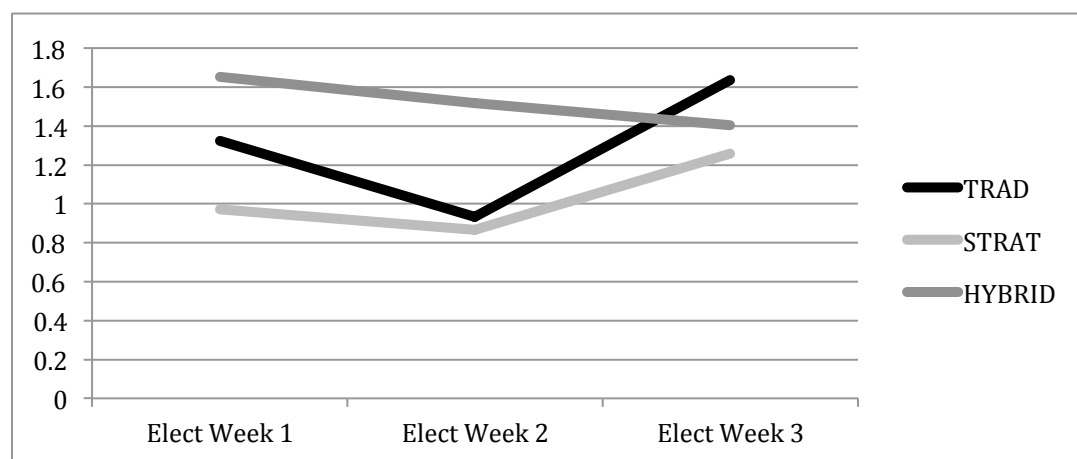
From Figure 12, it is possible to see that STRAT and HYBRID spent a fairly similar time on required activities. At the end of week 2, all students in TRAD missed a day because of a snow day. Most students seem to have counted this day off in the language learning log of Week 3 because of the drop by an hour. The Kruskal-Wallis test was used to determine if there were any statistically significant differences between the groups. None of the differences were statistically significant, p-values ranging from .371 to .844. Table 8 shows the average time spent for each group on required class work along with significance of differences between those groups for each week.

**Table 8.** Average Time Spent on Required Activities for the Pronunciation Workshop Each Week by Group

Group	WK 1 Ave Time	WK1 SD	WK 2 Ave Time	WK2 SD	WK 3 Ave Time	WK3 SD
<b>TRAD</b>	3.20	1.95	3.20	1.42	2.20	0.95
<b>STRAT</b>	3.00	1.56	2.93	1.83	2.79	1.64
<b>HYBRID</b>	3.08	1.08	3.17	1.23	3.08	1.56
<b>Sign.</b>	.844		.585		.371	

Similarly, the elective time spent each week was calculated for each group for each week.

Figure 13 shows the changes for each group each week.



**Figure 13.** Time spent on elective activities for pronunciation workshop for each week by group

Interestingly, while all groups showed a decline in time spent on elective pronunciation practice from Week 1 to Week 2, groups TRAD and STRAT showed an increase from week two to three while HYBRID continued a decline. There is no explanation for this relationship in the interviews, focus groups, or the open-ended questions on the language learning logs. The Kruskal-Wallis test was used to determine if there were any statistically significant differences between the groups. None of the differences were statistically significant, with p-values ranging from .152 to .801. Table 9 shows the average time spent for each group on elective class work along with significance of differences between those groups for each week.

**Table 9.** Average Time Spent on Elective Activities during the Pronunciation Workshop for Each Week by Group

<b>Group</b>	<b>WK 1 Ave Time</b>	<b>WK1 SD</b>	<b>WK 2 Ave Time</b>	<b>WK2 SD</b>	<b>WK 3 Ave Time</b>	<b>WK3 SD</b>
<b>TRAD</b>	1.32	1.53	0.93	0.61	1.64	1.27
<b>STRAT</b>	0.97	1.14	0.87	0.64	1.26	0.92
<b>HYBRID</b>	1.65	0.82	1.51	1.12	1.40	1.16
<b>Sign.</b>	.152		.373		.801	

Although there were no statistically significant differences between time spent during the workshop, differences emerged after the workshop.

#### **After the workshop**

All 48 participants in the study took a delayed post-survey 1.5-2 weeks after the end of the pronunciation workshop. The delayed post-workshop survey asked them to report time spent and activities used for pronunciation learning in the past week. The Kruskal-Wallis test of significance was used to determine if the differences in time spent on pronunciation learning activities, number of pronunciation practice activities used, or frequency of use for each type of potential activity differed across groups. Time spent was calculated in hours. The number of activities was calculated by counting the number of activities students mentioned using in the



past week. Frequency of use was selected from a range of never to more than 4. Results showed that there was a significant difference in the times given in response to the question, “Around how many minutes did you spend practicing English pronunciation in the past week?” as well as in frequency of use of ASR in response to “In the past week, how many times have you used the following activities to improve your pronunciation?” for “Work with dictation software programs (such as Siri on the iPhone).” Table 10 shows responses to the delayed post-survey as averages by group along with the p-value for each item comparing across groups.

**Table 10.** Autonomous Learning Behaviors by Group

Item	TRAD Ave	TRAD SD	STRAT Ave	STRAT SD	HYBRID Ave	HYBRID SD	Sign.
Time Spent (in hours)	1.46	1.13	1.31	1.87	4.16	4.43	<b>.011</b>
Number of Activities	5.13	2.56	4.59	1.87	4.63	2.63	.792
English Class	3.40	1.50	3.00	1.37	3.38	1.67	.577
Talk to NS	3.93	1.16	3.82	1.13	4.31	0.95	.412
Private Practice (Covert Rehearsal)	2.53	1.60	2.47	1.97	3.25	1.48	.387
English Teaching Software	1.33	1.88	1.00	1.54	1.44	1.59	.620
Dictation Software	2.27	1.91	1.12	1.21	2.38	1.31	<b>.041</b>
Online Resources	1.60	1.77	1.94	1.71	2.5	1.86	.324
Online English Lessons	1.87	1.69	1.35	1.77	1.94	1.48	.452
Watch Movies	3.27	1.53	3.47	1.42	3.56	1.21	.897
Focused Listening	3.27	1.58	2.71	1.61	2.94	1.65	.562
Dictionaries	3.27	1.71	3.76	1.64	3.75	1.53	.548

Mann-Whitney U was used to test between which groups the differences were significant. For time spent, the difference between HYBRID and STRAT was significant ( $p=.005$ ), with an effect size of 0.48, and the difference between HYBRID and TRAD was significant ( $p=.041$ ), with an effect size of 0.37. For dictation software, the difference between HYBRID and STRAT was significant ( $p=.014$ ), with an effect size of 0.44, but the difference between HYBRID and TRAD was not.

In the interviews, only one student in TRAD reported continued use of a dictation software, so it is unclear why students reported such high use in the delayed post-survey. It is possible that students either did not fully understand what dictation software was because they had not been introduced to it in class or that some of the students not interviewed were actively using the program.

Students explained in the interviews why they found ASR useful or not useful. Focus groups followed up on many of these issues, exploring why students chose to continue or discontinue use with ASR after the end of the course. The responses highlighted the fact that while there were many benefits of ASR, WSR, in particular, had many drawbacks that prevented students from wanting to continue with WSR (although many were still considering other ASR options).

### **Choosing to continue or discontinue use of ASR**

#### Benefits of ASR

Students generally had positive reactions to working with ASR. It was described as helpful or useful by six participants, easy to use by two participants, as well as fun, interesting, exciting, good, and cool each by one participant. Three students give their reactions to ASR in the following:

GE- 2: I think it didn't use it before and now I think it's a useful software so I feel a little excited

STRAT- 4: It was fun. I didn't even know that I had that type of technology in the computer and it was fun.

HYBRID-11: It's interesting to learn English by

### Helpfulness

Students recognized that the program had the potential to help them with their pronunciation. It was described as helpful or useful by six participants. They thought it was useful because it provided feedback. While, as part of the minimal strategy training, students were told that the program could be useful because it provided a transcription which could be used for feedback, eight participants clearly agreed and brought up the usefulness of the technology because of it giving feedback as part of the interviews.

STRAT-4 Cause um it helps you if you say the words wrong and the WSR reads it differently that means you are saying it wrong so you know what's the problem with your pronunciation so it's helpful

HYBRID-11: It can give feedback. I say it; it can give me the information I said.

Overall, while students found the low recognition of the program frustrating, particularly on the first try, they recognized the benefit of practice with a program that would identify errors. One student in the focus groups said, "At the beginning I feel uncomfortable to use WSR. I tried a lot of times and I uh at the beginning I feel it's a waste of time to practice it, but after it helped me correct my pronunciation on some words I feel more comfortable" Further, although it was frustrating when ASR did not recognize the words, this made it more meaningful for some students when the program was able to recognize what it should. HYBRID-5 explained, "You know if the machine can understand you speaking, it's much easier for people to understand you." For some students getting positive feedback, accurate recognition, then also became very motivating. HYBRID-1 stated, "it can record my error directly and when it recorded right it inspired me."

### Other Benefits

Students also pointed out another benefit of ASR, that they could avoid some of the problems of relying solely on face-to-face interaction with another person, time constraints, lack of focus on pronunciation, and embarrassment or anxiety. Whereas conversation with another person requires that another willing participant, a conversation partner, be available for practice, ASR is available at all times of the day for use. STRAT- 1 says, “I just think that a good point of that tool is I can practice myself whenever I want.” Also, when talking to another person, it can be difficult to focus on pronunciation when members need to be constantly focusing on either meaning creation or meaning understanding. STRAT-9 explained, “So you know when we talk with other people we cannot focus on our pronunciation because we need to finish the whole sentence and make other people understand that but for the teachers and native speakers they may understand what you what did you say for the meaning but they don’t want to point out your pronunciation is not very good, but if we use that program we can you know pay more attention to our pronunciation.” Finally, while talking to others in a second language can cause anxiety, one student thought that ASR provided a solution. STRAT-1 said, “I feel free with using that tool because if I keep wrong pronunciation it will be fine because nobody knows.” While students generally had positive feedback regarding ASR, WSR garnered much more varied reactions.

While students generally recognized WSR as useful (with the exception of the first week), finding it helpful for providing feedback in pronunciation practice, only six of the HYBRID interviewed stated liking the program itself. Six specifically stated not liking WSR. Five of those six, however, found other ASR tools that they liked better. Most students of HYBRID did not plan to continue work with WSR. Only one student reported in the focus group plans to continue with WSR, three students said maybe, and six said they did not intend to use

WSR again. The biggest complaint regarding the program was convenience, but students also cited low recognition and technical issues specific to WSR.

### Drawbacks of ASR

#### Convenience

Many of the participants pointed out in the interviews and focus groups that they were busy college students and little time for extra practice.

STRAT-1: Yeah um really busy these days

STRAT-10: Yes I am busier because the class is more difficult so I will less time so that's all

Students pointed out that there were limits to their motivation under such time constraints and without a teacher or homework pushing them to do work, they did not consider themselves to have a lot of extra time to do elective work on their pronunciation. In response to this lack of extra time, many students pointed out that they used e-dictionaries because of convenience. Many had e-dictionary applications on their phones and liked the convenience of being able to quickly pull their phones out to look up a word they needed, even in public places or in the middle of a conversation with another.

STRAT-2: Usually I speak uh good, but the pronunciation is not good, so the shopper can't help me so I usually use the dictionary to correct my pronunciation.

HYBRID-5: I have a software on my phone, which is like electronic dictionary. If I don't know how to speak the word correctly, I look up the words on the e-dictionary which is on my phone...the e-dictionary will speak it.

The convenience of the dictionary was actually contrasted with the inconvenience of WSR. HYBRID-13, said, "I think e-dictionary is efficient. We can use our cell phones to search

for words and we can use it everywhere, but WSR we can only use it in our computers.” Four other students also specifically mentioned that WSR is not convenient. Students were frustrated that they had to sit down, open up an often bulky laptop, start up WSR in their computer, and take a chunk of time to work on their pronunciation. They preferred apps on their phone that they could quickly bring out and use, such as e-dictionaries. They preferred the ability to work with one challenging word at a time (when they recognized a need for the word or had a communication breakdown with another person), but thought that the effort of getting WSR started was too much to be worth the hassle for only one word. Many of these students were considering continuing practicing with Siri or Dragon Dictate, which are available on iPhones and iPads.

#### Low Recognition

While students still thought that practice with WSR was useful, many still got very frustrated with the low recognition rates. The low recognition was a particular problem in the first attempt with the program, but for many continued to be a source of frustration even in later attempts.

HYBRID-3: It’s the hardest work I’ve ever done...before I tried like more than 20 times, at least 20 times and none of them is right...I can’t do well in assignment the first time, but I can get all the correct answers in the last time

HYBRID-4: I don’t know about the performance other people have with WSR, but for me I just don’t-I just can’t. I just don’t know why WSR can’t figure out what I am saying. Every time I spoke a word WSR always gave me the wrong word.

HYBRID-5: Yeah from the very beginning that program made me crazy. No matter how many times I say the single word it comes out another word... the first time it really, really wasn't not simple, don't want to say a waste, but really spend a lot of my time

This led many students to then either doubt the ability of the program or to doubt themselves and their pronunciation ability. Seven students mentioned some form of doubt regarding the program's ability.

HYBRID-3: So I asked my roommates, three American native speakers, [to record in WSR] and none of them got the correct answer.

HYBRID-10: I mean I think I speak like correctly, but when I mean when I'm speaking different like I'm using my phone my phone can recognize what I'm trying to say but when I'm using the computer it's like yeah it's difficult... I'm just confused because the computer seems like maybe the windows says its not perfect so it cannot recognize what I'm trying to say...um probably the problem would be with the program. Maybe I'm not pronouncing it exactly the way the program wants me to pronounce it

On the other hand, some students began to wonder if their pronunciation was terrible. Although part of this stemmed from the heightened awareness of pronunciation issues in their speech, some students seemed to lose confidence in themselves from working with the program.

HYBRID-4: At first, I am very frustrated. I thought maybe I pronounce very badly.

HYBRID-6: Sometimes it didn't work very well because I don't know, maybe my pronunciation is a little strange or something... The thing I may think there is something wrong with my pronunciation?

It is interesting to note, however, that one student in STRAT who used a different software thought the recognition was too high to be useful. STRAT-8 stated, "The results turns I

can be good; I act very good in this technology. Maybe I feel very confident so I think I don't need this technology." This indicates that there is a necessary middle ground in recognition levels for a program to be helpful for pronunciation practice. Students recognize for the program to be helpful it has to alert them to their errors, but if it alerts them to too many or never indicates pronunciation improvement, students may feel frustrated and not get enough encouragement or positive feedback. Beyond low recognition, there were also other technological concerns that impeded practice with the program for pronunciation purposes.

### Technological Concerns

WSR presented technological concerns that students using other ASR technology did not experience. First, three students that had their PC set up for their native language were unable to download and install successfully the extra WSR recognition pack for English. If they did not have access to a friend's computer, they ended up having to use the computer labs on campus, which was uncomfortable for many because they were forced to make noise in a normally quiet lab in order to finish the assignment. HYBRID-9 said, "sometimes if I use the computer in the lab of the library of our college it's not very convenient because I will make the noisy sounds and uh have an effect on other people so I don't like to use it." Although it was possible for these students to check out from the university laptops that would have the program, allowing them to take the program practice to a private location, none of the students reported having taken advantage of that university service.

Another feature of WSR that is different from the applications students used, Siri and Dragon Dictate for the iPhone and iPad, is that while WSR dictates it also listens for commands to control programs. When one student ran into the word "cut" on the WSR guide sheet for Week 3 of the pronunciation workshop, he ran into problems with the program misunderstanding the



dictation for a command. HYBRID-6 explains, saying, “sometimes I say cut that will be a command, like cut the word to another part.”

Through working with WSR, and, for some students, with other ASR dictation programs, students developed ideas for what they would like to see in a perfect ASR program for pronunciation improvement.

### **The dream ASR program**

During the focus groups students had the opportunity to describe modifications they would like to see with WSR to make it a program that they desired to use. The only suggestion that they had for the current WSR was to improve the levels of recognition to make it less frustrating for practice. Most of the suggestions were to add features to the program to make it more appealing and functional as a language learning software. The following suggestions give an idea of students’ vision of a dream ASR program:

- Make it mobile for convenience
- Include recordings of target words (or at least phonetic transcriptions) like in e-dictionaries
- Make it easy to open and easy to close for convenience
- Have WSR give suggestions based on errors to help students make corrections
- Make text-to-speech technology also possible so that students can type in any sentence and hear it
- Create opportunities for interaction, like in Siri
- Improve the design of the program to be more visually appealing

Several students, in particular, mentioned the first two items on the list. While the first feature, a version as a mobile application for convenience, exists in currently available software

such as the applications Dragon Dictate and Siri, the program that many of these students envisioned (with built in dictionary and feedback while still allowing the current levels of flexibility) does not exist. Many pronunciation teaching software programs have eliminated the flexibility of choice in order to facilitate the other features. Thus in many pronunciation programs, the student cannot bring in materials, words, and phrases of their own choosing, but must follow the lesson of the program.

The included dictionary was particularly important to the group, mentioned by many students. In fact, four students specifically mentioned during the interviews that they had developed the tactic of working with an e-dictionary to improve success while working with WSR. HYBRID-5 explains, saying, “Yeah from the very beginning of that the program made me crazy. No matter how many times I say the single word it comes out another word. (I: yeah?) So I have to check the dictionaries and listen to the dictionary recording many times so I can pronounce it right so the machine can recognize my voice. Yeah but after that I think maybe it’s a struggle at first, but it did improve my pronunciation.”

### **Summary of Results**

The results from the study provide the following main findings. Students from all groups reported feeling more motivated to work on their pronunciation because they developed a heightened awareness of their pronunciation through the pronunciation practice and feedback received during the workshop. Many students reported wishing that the pronunciation workshop could last longer than three weeks. But only the experimental groups (STRAT and HYBRID) were successful at increasing beliefs of autonomy. Results showed that STRAT and HYBRID both significantly increased their beliefs of autonomy from the pre- to post-workshop survey (for STRAT  $p=.006$  and for HYBRID  $p=.013$ ), while TRAD did not ( $p=.727$ ). Students found ASR

to be a useful tool for autonomous practice because it provides practice opportunities with feedback. Students explained that, although ASR is frustrating during the first attempt, they were able to develop additional strategies to help them make work with the program successful.

While there were no differences between the groups in terms of required or elective pronunciation practice during the workshop, the hybrid sections utilizing ASR for half of the course work (HYBRID) reported significantly more time spent on autonomous pronunciation learning than STRAT and TRAD after the pronunciation workshop ( $p=.011$ ). Further, HYBRID also reported significantly more use of dictation software for pronunciation practice after the workshop than STRAT ( $p=.041$ ). Students explained that they became more comfortable with the program through repeated use and appreciated the feedback given by the program. Some students, however, did not plan to continue using WSR because of the lack of convenience of the computer program (desiring instead a mobile application that could be used anywhere) and the frustrating low recognition. These students were considering using other ASR programs, such as Siri or the Dragon Dictate application, which has a higher rate of recognition. When describing what they envisioned as the perfect ASR program, students primarily pointed to the need for it to be available as a mobile application for phones and tablets as well as the need for it to incorporate features of e-dictionaries, particularly the recordings or phonetic transcriptions of words.

## **CHAPTER 5: DISCUSSION AND CONCLUSIONS**

This study investigated the effect of the introduction of ASR on pronunciation learners' autonomy. It explored two different facts of autonomy by examining both autonomous learning beliefs and autonomous learning behaviors. Using two experimental groups, it examined differences in the autonomous learning beliefs and behaviors developed through minimal strategy training and hybrid course design. This chapter summarizes the results of the study, while making connections to previous research and discussing implications of the findings. The limitations of the current study are discussed, as well as directions for future research. Finally, conclusions are provided at the end of the chapter.

### **Discussion**

The results of this study show that both treatments, the minimal strategy training in ASR incorporated into a traditional F2F course, and the hybrid with minimal strategy training and half of the work using ASR, were equally effective for students to develop beliefs of autonomy in their pronunciation practice. Both experimental groups significantly improved in beliefs of their own autonomy while the control group that received traditional pronunciation teaching did not. There were no significant differences between the two experimental groups in the change in their autonomy. This is in line with Benson and Voller (1997), who pointed out that strategy training is an important aspect of autonomy development in technical versions of autonomy as a way of increasing capability to learn autonomously. Oxford (1990) explained that language-learning strategies are important because they are “tools for active, self-directed learning” (p. 1). This research confirmed that the introduction of strategies can positively affect students' beliefs of autonomy and both methods (traditional face-to-face with minimal strategy training or a hybrid with half of the work using ASR) could be useful as part of a gradualist approach to help

students feel more capable of working on their pronunciation on their own. Seven of the twelve students interviewed in HYBRID (58%) specifically pointed to the introduction and use of ASR as the reason they felt they had more resources and tools for pronunciation practice. Four others indicated later that they believed ASR was useful for pronunciation practice. In particular, students in particular appreciated getting feedback on their pronunciation.

While previous research into the effectiveness of ASR training for pronunciation improvement has shown that ASR can be useful for improving pronunciation accuracy in production (Hincks, 2003; Neri, Cucchiarini, & Strik, 2006; Neri, Cucchiarini, & Strik, 2008; Neri, Mich, Gerosa, & Giuliani, 2003), this is the first study to show the usefulness of ASR for fostering autonomy. This research is therefore in line with previous research into technology for autonomy development (such as Figura & Jarvis, 2007; Kruk, 2012; Luke, 2006; and Murray, 1999), which has suggested that the introduction of technology can be useful for developing and fostering students' autonomy.

Out of all the students that reported trying ASR in the interviews (19 across all groups), 84.2% had positive reactions overall, stating that it was helpful for pronunciation. ASR allowed for extensive experimentation with English pronunciation, an aspect of autonomous learning critical in Schwienhorst's (2008) framework. Students recognized that they were unable to hear their own pronunciation mistakes, as Beddor and Strange (1982), Blankenship (1991), and Flege, Munro, and Fox (1993) suggested, indicating that sounds in an L2 are filtered through the phonological system of the first language (L1). Because students struggle to monitor themselves, many students de-valued practice with covert rehearsal because they could not get the feedback they needed to improve. Sheerin (1997) pointed out that feedback on practice and experimentation is essential for students' autonomy development and the success of self-access

work. ASR-based programs are the only current technological resources for pronunciation students that provide feedback so that students are less reliant on the teacher or a native speaker for constant feedback.

Also, during the interviews many students mentioned that they had experienced issues with anxiety when speaking with others, an issue brought up by MacIntyre (2007) who described language anxiety as “the worry and usually negative emotional reaction aroused when learning or using an L2” (p. 565). High language anxiety is likely to negatively impact performance in the L2 as well as lead to avoidance of such interactions (MacIntyre, 2007). One student pointed to ASR as a solution, stating that when she worked with ASR she did not have to worry about embarrassment when she got the sounds wrong in the way that she worried when she spoke with others and that without the worry of judgment from ASR she was able to try words over and over again until the program recognized what she was saying. ASR addresses a need stated by Schwienhorst (2008) that “learners need to become experimenters with and explorers of language and language learning in a laboratory-like, stress-free environment” (2008, p. 9). This finding also supports the research of Banafa (2008) who stated that computers can “provide safe environments for practicing pronunciation and oral language” (p. 119). ASR allowed students the safe space that they needed to perform the extensive experimentation with the language needed for autonomy.

Further, one student pointed out that ASR addressed another problem of relying solely on communication and interaction with other speakers of the language for pronunciation practice, that is, because of the focus on sharing meaning, many pronunciation errors may not get attention or correction. Conversation partners are unlikely to interrupt the flow of conversation to correct the speaker’s pronunciation. Negotiation in communication, and subsequent noticing,

outside of the classroom is more likely to happen when meaning is lost. While some pronunciation errors may lead to full communication breakdowns on their own, many pronunciation errors may only cause communication breakdowns when they co-occur with other pronunciation errors. Other pronunciation problems may only slow processing times or cause a loss of perceived comprehensibility. Conversation partners may be hesitant to interrupt the flow of the conversation if meaning is not obstructed by the pronunciation in the particular utterance. Further, even when communication breakdowns do occur, knowledgeable conversation partners, even native speakers, may lack the ability to identify specifically what has caused trouble in the learner's pronunciation. From interaction alone, a learner may not recognize many of the pronunciation problems that are negatively impacting their communications with others. Negotiation of form or corrective feedback, on the other hand, is more typical of classroom settings and interactions with a teacher (Ellis, 2008; Russell & Spada, 2006). Further, while focusing on meaning, students may struggle to focus on their pronunciation accuracy while the goals of fluency and meaning creation are all competing at the same time. Allford and Pachler (2007) pointed out that decontextualized language study can be a useful complement to the language study achieved through communication and interaction because private practice can allow the learner to focus on language specifics without the distractions that a context or setting would provide. One participant in this study was excited that while working with ASR he was able to focus on his pronunciation the whole time and was able to stop talking to the ASR program at any point to go back and work on his pronunciation when the dictation gave him an unintended transcription.

Although there are certainly benefits that ASR can offer to students for pronunciation practice over conversation with others, especially those that have high anxiety, many students in

all groups mentioned that through the pronunciation workshop they gained self-confidence in their pronunciation ability and felt less anxiety after the workshop about potential interactions with native speakers. This is encouraging for all classes because, while autonomy is often presented in isolating terms such as independence or freedom, which can be seen as release, exclusion, or exemption from constraints imposed by others, it is important to keep in mind always that language is intended for communication with others and thus requires interaction with others.

The decontextualized language study through self-access practice with ASR was intended as a complement to learning through social interaction and addresses problems that a solely interaction-based approach presents. Allford and Pachler (2007) pointed out that “to recognise the importance of context to communication does not warrant a rejection of decontextualized language study” (p. 94). They continued by pointing out that by taking an aspect of language out of context (creating a model of the language used outside of the classroom in the real world) for work within the classroom allows certain features, patterns, or rules to be highlighted and practiced: “Once the item has been abstracted and particular features highlighted, it can then be recontextualized and its function of conveying meaning can be considered in various contexts” (p. 71). This idea is echoed in pronunciation teaching guidebooks such as Celce-Murcia, Brinton, and Goodwin (2010), which introduces many activities for pronunciation learning that take language out of context to allow for focused pronunciation work. Decontextualized work is never enough, however. The authors plainly stated that the goal of pronunciation practice and work is to allow the learner to subsequently “reproduce these features intelligibly within a large discourse context” (p. 305). Thus, while this study asked students to work with decontextualized language study through independent self-access work with ASR, the ultimate goal of the



pronunciation practice with ASR was to be able to apply and practice their new knowledge and skills in actual conversation with others. The fact that the pronunciation workshop, including group HYBRID with half of their practice with ASR, helped students gain confidence in speaking with native speakers is a positive development. While many participants indicated they previously had avoided interactions with native speakers when first moving to the United States, many left the pronunciation workshop excited about joining student groups on campus and working to build friendships with more Americans for practicing their language skills.

Of course, the discussion has thus far only considered students in an ESL setting that have reasonably easy access to native speakers. It is important to consider the potential of ASR for students that do not have easy access to native speakers for language practice. ASR would likely be even more beneficial in a foreign language learning setting. Many of the students in this study were excited to be making friends with native speakers and to have increased opportunities to talk to native speakers. They had other options for practice. In a foreign language learning setting, although it is usually relatively easy due to the internet and widespread media access to get high-quality language input for listening, it can be much more difficult to find chances for production practice, especially practice that also provides feedback on output. ASR could thus be invaluable for students in foreign language learning environments.

One of the surprising results of the research, however, was that both TRAD and HYBRID developed slightly greater dependence on the instructor during the workshop. While one of the goals of the treatments was to decrease student dependence on the instructor and to enable them to work on their pronunciation in the absence of an instructor because pronunciation training is often ignored or pushed to the side in favor of other skills (Isaacs, 2009; Kelly, 1969; Lang et al, 2012), HYBRID actually reported moved slightly in the other direction developing a greater

sense of dependence on the instructor. This is likely largely due to the short nature of the course. Many of the students in all sections stated that the three-week workshop felt too short and that they wanted help with many more sounds in English as well as further practice with the sounds already introduced. Students also may not have had enough time to become fully comfortable with the ASR program to the point that they felt it could help them in the absence of an instructor or course. This is not surprising in light of a gradualist position regarding autonomy. In gradualist positions, autonomy is seen as a long-term goal, one to be developed over time. It may be that through continued work with the program, students would continue to gain confidence in themselves and decrease the reported dependence on an instructor.

Work by Benson and Voller (1997), which indicated that self-access work without proper support and guidance may cause students to become more dependent on the materials that guide the work (p. 9), may also point to the nature of the work with ASR as the source of this backwards movement, however. While the HYBRID work with ASR was guided with handouts providing words, sentences, and activities, students were not trained in creating their own practice materials with ASR. This may have left students feeling that without an instructor they were not able to use ASR effectively. Future research should aim to train students to create their own training lessons with ASR so that they may feel less teacher dependent at the end of a course. Although the slight increase in dependence for HYBRID is an issue of concern to continue investigation into, evidence from the delayed post-workshop survey shows that HYBRID engaged in more autonomous learning behaviors after the end of the pronunciation workshop, indicating that despite some feelings of dependence students showed more autonomy than STRAT through autonomous learning behaviors after the course.

HYBRID reported more elective time spent on pronunciation learning as well as more use of dictation software as a pronunciation learning strategy after the end of the workshop. These differences were statistically significant. One reason for these group differences may come from enhanced motivation through working autonomously. This would be in line with Deci and Ryan (1985) who proposed that autonomous students are more likely to be driven by intrinsic motivation, which Brown (2007) claimed is a powerful form of motivation. Students in HYBRID were required to do self-access work with WSR, encouraging them to do much more experimentation with WSR as a language learning strategy. Through experimentation with WSR, students learned about what types of activities were most useful to use with WSR and developed further strategy use (e-dictionaries and covert rehearsal as preparatory practice for work with WSR) to make the WSR practice more successful. This may have allowed students of HYBRID to develop more interest or pleasure in the WSR work, which would drive intrinsic motivation. Although the Likert scale survey did not indicate significant differences between groups in motivation due to the pronunciation workshop, the larger amount of time spent and heightened use of dictation software may indicate that HYBRID developed a greater sense of intrinsic motivation through the extensive experimentation in WSR.

While there were concerns that students in STRAT would not be willing to try ASR, 62.5% of the STRAT students interviewed tried some form of ASR, mostly Siri or the Dragon Dictate app for iPhone or iPad. Of the TRAD group interviewed, 25% had also tried using ASR for pronunciation practice despite the fact that it was not introduced as a strategy in this group. It is important to note, however, that while 91.67% of the HYBRID students found the program useful, a lower percentage of students in TRAD and STRAT that tried using ASR found the program useful (80% for STRAT and 50% for TRAD). The one student of each of those groups

(STRAT and TRAD) that did not like ASR gave up after the first attempt, which was stated by the HYBRID group as the most frustrating attempt. Given the high percentage of students in HYBRID that found ASR useful, it is likely that a higher percentage of STRAT and TRAD students would also find the program useful if encouraged or required to use the program repeatedly. Further, this may also heighten students' use of ASR after the end of the course. HYBRID, which was required to work with the program every week, reported significantly more use of ASR after the end of the course. In order to encourage continued use with the program and to foster higher levels of motivation to continue pronunciation practice with the program, it is important to have students practice repeatedly with the ASR program so that they can become comfortable using it and can see its potential as a pronunciation learning tool.

Although this use of required activities may seem to work against politicized views of autonomy, such as Pennycook (1997), who aimed to emancipate students and give them more immediate control of their learning, this research supports a gradualist position as introduced by Allford and Pachler (2007) by seeking to help students develop skills and capability as autonomous learners over time. Although students in HYBRID were not immediately given freedom to make choices about their language learning, instead being pushed to work repeatedly with WSR using guided sheets, after the course was over the HYBRID group displayed significantly more autonomous learning behaviors. Further, the higher rates of students stopping work with ASR or never even trying the program in STRAT suggests that just giving students strategies may be insufficient to change their behaviors. While students introduced to strategies may feel more autonomous, they may be unlikely to incorporate the strategies into their language-learning repertoire without repetitive practice with the strategies through self-access

work that reassures students that they are capable of completing such practice successfully on their own.

### **Limitations**

Before discussing the many implications of this research, it is important to acknowledge the limitations of the study. One of the main limitations of this study arises from an extra variable present in the study. Although all three groups practiced with covert rehearsal in class through a form of buzzing (quiet concurrently occurring practice from all students of a class that leads individual practice to be indistinguishable) and with focused listening, through practice with TED talks, circling target words on a transcript of the talk, there was a difference in how these strategies were treated across groups. While TRAD practiced with the strategies in class, this group was not told that these were strategies that they could also do outside of class. STRAT was told that covert rehearsal and focused listening were strategies that they could use outside of class, but were also told about ASR. HYBRID was told about the same strategies as STRAT, but actually spent about half of their class time using ASR. Because students in STRAT and HYBRID were presented with training in three different pronunciation practice strategies during the minimal training aspect of the first day of each week it is difficult to claim that ASR was the sole reason that students' beliefs of autonomy grew in groups STRAT and HYBRID. However, ASR is the one thing that TRAD was not exposed to while all groups were exposed to covert rehearsal and focused listening in class. Further, students in HYBRID (and some in STRAT) clearly pointed to ASR as the main reason that they believed that they had more resources or tools for pronunciation practice and the hybrid design, with half of its work with ASR, seems to have favorably affected HYBRID's autonomous learning behaviors. Still, future research should be careful to avoid such a potentially conflating variable.

Another limitation of this study was the number of students. Despite running the study in six courses, due to the small course limits for the 99L courses at Iowa State University (16 students maximum per course) and the loss of some students to the exclusion criteria (students missing more than one day's worth of work or any of the surveys were removed from the data), groups remained small with only a total of 48 participants. However, the groups were large enough to show clear trends in the data, allowing for statistical significance to emerge. Further, because of the extensive qualitative data gathered through interviews, focus groups, and open-ended questions on the language logs, triangulation across the quantitative and qualitative data was possible, strengthening the claims. Having larger groups, however, may allow group distinctions to more clearly emerge.

### **Implications for teachers**

This research study has many implications for teachers. First, this study shows that strategy training is an important element in helping students develop belief in their own autonomy. Minimal strategy training, a few minutes per week, may be sufficient to change students' beliefs of autonomy. Most importantly, though, ASR is a useful tool and strategy that should be introduced for pronunciation practice. A simple handout, with directions for downloading (if necessary), for starting up an ASR program, and for using ASR dictation as feedback on pronunciation, was sufficient for many students in these workshops to get started with the program. ASR based programs are the only technological resources for pronunciation students that provide feedback so that students are less reliant on the teacher or a native speaker for constant feedback. The feedback also made practice more meaningful by allowing students the feedback that allowed them to improve. Students appreciated the feedback, which allowed them to focus on their errors and discover areas of weakness.

Further, ASR is useful in both foreign and second language learning contexts. In the foreign language-learning context, ASR is likely to be an invaluable tool for teachers of foreign language learners who do not have as easy of access to native speakers. Even for students with easy access to language speakers, ASR was useful in that it allowed students the safe space (safe from the anxiety that may accompany communication with others) that they needed to perform the extensive experimentation with the language needed for autonomy. Further, ASR pronunciation practice can be a useful complement to the language study achieved through communication and interaction because private practice with ASR can allow the learner to focus on language specifics without the distractions that a conversational context or setting would provide. Further, in all sections, including HYBRID, the ASR hybrid, students developed more confidence in their language abilities, making them more excited to seek out opportunities for interaction.

For teachers interested in incorporating ASR into the classroom, it is important to take note of a few of the challenges of using ASR. Students may need repetitive practice with the program before they feel comfortable using it. The first attempt, in particular, is likely to be frustrating and without encouragement and requirements of use students may give up. Further, the repeated practice may heighten student motivation to for pronunciation practice and for work with an ASR program. The larger amount of time spent on pronunciation learning and heightened use of dictation software by HYBRID may indicate that they developed a greater sense of intrinsic motivation through the extensive experimentation in WSR. To make sure that most students give the program a fair shot (giving it at least two attempts), it is recommended that students be required to work with ASR for multiple assignments in a course, giving students

time to become comfortable with the program and to experiment with ASR as a language learning tool and strategy.

### **Implications for software developers**

This research study shows that there is a need for new program development. While most current language learning software programs guide students through developed lessons and topics, students in this study appreciated being able to choose what words and phrases to bring into the program. While this ability exists in current dictation programs or voice search applications, students wanted an ASR program that also allowed them to search for words to learn the pronunciation first, either through dictionary-like recordings or through text-to-speech technology. Students also wanted the program to be able to give them some feedback based on what was transcribed to help them produce what was intended. Given the open nature of the dictation programs (the way that students can bring in any word or phrase), this would certainly be a great undertaking for program developers, but could lead to an indispensable tool for language learning.

While advancing and adapting the abilities of dictation programs to allow for language learning is needed, the ASR underlying the dictation program proved to be at a useful level of accuracy. Although teachers and researchers have in the past voiced concerns over the low accuracy of ASR for non-native speech, this study suggests that the current level of voice recognition in dictation programs for ESL speech is at a high enough level to facilitate pronunciation practice for intermediate to advanced learners. While some students voiced frustration over the low recognition of WSR, most of those students were able to find another ASR program with a recognition level that better suited their learning needs. Most students were



able to find an ASR program that provided a useful balance of accurate and inaccurate transcription.

It is important to note that, when used as a language-learning tool, the goal of dictation software ceases to be perfect recognition. Instead, the goal becomes finding a balance between accurate and inaccurate transcription. When a program provides a higher level of correct transcriptions the student fares better emotionally, getting less frustrated and overwhelmed. Further, a suitable level of correct transcriptions helps students focus on areas of incorrect transcription to work on. Incorrect transcription then shows students the areas that they need to improve. If the program showed only incorrect transcription, the program would be meaningless, offering overwhelming negative evidence likely to cause the student to doubt himself or to doubt the program. If the program showed only correct transcription, the program would not be useful because it would indicate no areas to work on. Students in this study easily grasped that, although the programs were not perfect at dictating their speech, the imperfect recognition was actually an advantage for their pronunciation practice. Further, this study shows that programs such as Siri, Dragon Dictate, and Google Voice Search have reached that ideal balance for intermediate students. The increased frustration with WSR may indicate that WSR's higher sensitivity to non-native speech may strike an appropriate balance only for advanced students.

### **Implications for researchers**

While previous research into ASR has focused on production improvement, this is the first study to show the usefulness of ASR in another aspect of language learning, autonomy. This research study has opened up many questions and directions for future research, but has also taken a step toward improving the quality of autonomy research. Future research should aim to

be more rigorous, a need called for by Nguyen (2012). To better address the need for rigorous autonomy research, this study:

- 1) examined both pre- and post-measures of autonomy
- 2) collected both quantitative and qualitative data
- 3) investigated more than one aspect of autonomy (beliefs AND behaviors)

By collecting pre-, post-, and delayed post-measures of autonomy, this research study was able to track changes in autonomy over time. This allowed the researcher to take into account starting levels of autonomy. This is important because even the scores collected at the beginning of the workshop showed some level of positive belief of autonomy (average autonomy scores pre-workshop ranged from 2.79 to 2.91, all of which are above the neutral or median score of 2.5). By collecting both quantitative and qualitative data, this study was not only able to show that differences between the groups were significant, but also to explore in-depth the perceptions and feelings of the participants to better explain the source of the differences between groups. Findings from the interviews and focus groups were invaluable in understanding why students' beliefs of autonomy changed and how students were making choices to continue or stop working with ASR. By investigating more than one aspect of autonomy, both beliefs and behaviors, this research study was able to give a broader picture of student autonomy. This is important because while both treatments equally impacted beliefs, they did not equally impact behaviors. Future research should continue to strive towards rigorous methods for measuring autonomy by examining both pre- and post-measures of autonomy, collecting both quantitative and qualitative data, and investigating more than one aspect of autonomy, as well as by working to improve and refine the methods by which autonomy can be measured. For example, research into technology and autonomy should explore ways of

measuring autonomous learning behaviors beyond self-reports, such as tracking learning behaviors in a program or website. Course management sites such as Moodle already offer some measures to track learning behaviors, such as checks on the links that have been followed by students. Other programs may be needed, however, to fully track autonomous learning. The following section provides directions for future research that have emerged from this study in need of further rigorous research.

### **Directions for future research**

As mentioned in the limitations section, future research should investigate the effect of solely using ASR on the development of student autonomy, being careful to avoid an effect from other strategy introduction. Also, future research should aim to include more participants to allow group differences to more clearly emerge. While this study does present some limitations, it has highlighted the potential for ASR to help students become more empowered as pronunciation learners. It has also, however, raised many new issues that should be addressed in future research.

First, about half of the students were frustrated with WSR, either due to its lack of convenience or low recognition. While WSR was useful for requiring students to work with ASR because students could easily submit their work with the program, students may benefit from being encouraged to explore the different ASR options available. This would allow students to experiment with more language learning tools and resources to choose what works best for them in terms of personal preference, convenience (a major factor for students who worked with WSR), and recognition levels. Students working with WSR that were frustrated by low recognition could be encouraged to move to another program such as the Dragon Dictate application to receive higher levels of dictation accuracy and less frustration. Further, the higher

rates of recognition may help avoid two problems students working with WSR in this study developed, doubts of the program (concern that the program was faulty) and doubts of their pronunciation ability (concern or lowering of self-confidence regarding pronunciation ability due to large amounts of negative feedback in dictation). On the other hand, students who find programs to have too high of recognition could be encouraged to try WSR, which was a bit more sensitive to pronunciation issues. Thus, a research study that could develop flexible ASR options for the required pronunciation work would be useful. A useful approach may be to encourage or require students to experiment with multiple ASR options and then choose one for their work throughout the rest of the semester.

Further, a comparison of how students work with the different ASR programs, potentially through talk-aloud protocols, may be useful for determining how students choose to continue or stop working with a particular program as well as what features of the different ASR programs best facilitate pronunciation practice for the students. Encouraging experimentation with different ASR programs and examining reactions to ASR work may also help determine optimal levels of recognition, determining what level of low recognition becomes overly frustrating and what level of high recognition makes the program seem useless for noticing errors and practicing. To address concerns of dependence, future research should also work to help students develop their own lessons with ASR to try to combat the increased teacher dependence reported by HYBRID.

Finally, all students seemed to appreciate the freedom and flexibility that dictation programs afforded them for pronunciation practice. No student requested a guided lesson that required them to move through particular words or phrases. Students instead wanted a built in dictionary function (or text-to-speech) as well as improved feedback in a mobile accessible

format. To my knowledge such a program does not currently exist that would allow this combination of program features. The development and testing of such a program could potentially provide students with a particularly useful tool for their pronunciation experimentation.

### **Conclusions**

Although the limitation of students' introduction to multiple strategies makes it hard to know exactly whether ASR alone would significantly increase students' beliefs of autonomy, results from the interviews suggest that students recognized ASR primarily as the tool most useful for expanding their repertoires of strategies for pronunciation practice. Students introduced to ASR in the pronunciation workshop significantly improved in beliefs of their autonomy. Teachers interested in getting started with ASR, but perhaps also unsure of how to get started with such a new technology, should see the student guide to getting started with WSR (Appendix A) and the example student practice guide sheet for the first week of practice with WSR (Appendix I). Further, results suggest that spending even minimal time (a few minutes a week) in strategy training, teachers can help their students realize opportunities for practice and become more autonomous learners.

Finally, incorporating repeated practice with ASR into a course allows students to become more comfortable with the tool, integrating it more fully into their repertoire of skills, leading them to practice more with ASR after the end of the course. Students in HYBRID who were required to work with WSR repeatedly due to the hybrid nature of the course showed significantly higher time spent on autonomous learning and frequency of dictation software use after the end of the course. Given that teachers often do not have sufficient time to cover pronunciation in class, it may be easy to see ASR work as an extra burden and teachers may be

hesitant to turn courses into hybrids. Instead, ASR should be seen as a potential solution to this problem. ASR work could easily be turned into homework for students in speaking classes, where students have a chance to practice and focus on their pronunciation (perhaps focusing in each practice session on a pronunciation issue targeted in a mini-lesson given in class), freeing up class time for other speaking activities.

While researchers have previously shown the value of autonomy, and many theorists suggest that autonomy is an important language-learning goal, there has been little research that examines practical ways for teachers to help their students become more autonomous learners in pronunciation learning. This study has shown an easy and realistic way to help students feel more autonomous in their pronunciation learning and to motivate students to become more autonomous in their language learning behaviors. Given the potential for ASR as part of pronunciation learning and teaching, this study has also pointed to exciting directions for further research.

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## APPENDIX A: STUDENT GUIDE TO USING WSR

### Directions for Using Windows Speech Recognition

Windows Speech Recognition in Windows empowers users to interact with their computers by voice. You can dictate documents and emails in mainstream applications, use voice commands to start and switch between applications, control the operating system, and even fill out forms on the Web.

**You probably already have speech recognition on your computer. Find it on your computer:**

- Open Speech Recognition by clicking the Start button , clicking All Programs, clicking Accessories, clicking Ease of Access, and then clicking Windows Speech Recognition.
- **OR** Open the Start Menu (bottom left of screen), type in the search bar “Speech Recognition”, then click Windows Speech Recognition

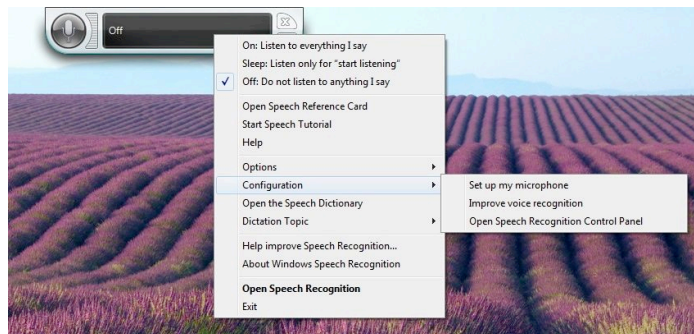
### Start Using Speech Recognition

#### To dictate text

1. Open Speech Recognition
2. Say "start listening" or click the Microphone button to start the listening mode.
3. Open the program you want to use or select the text box you want to dictate text into.
4. Say the text that you want dictate.

#### Improve the Program's Recognition

1. Right click on the program tab (the drop down program display- see image below)
2. Click on “Configuration”
3. Click on “Improve voice recognition”
4. Go through the training provided by the computer, reading the text.



## **Tips for Using Windows Speech Recognition to Practice Pronunciation**

- Focus only on the words that have the focus sounds in them. If the program doesn't understand the sentence, but understands the focus word you have done great!
- If the program doesn't understand the word, but gets the focus sound, then count that as a success. For example, let's assume the target sound is /r/. If I say "right" and the program thinks I say "ride", then I count that as correct.
- If you get a sound wrong, repeat it. Try it up to three times.
- If the program doesn't get it after three tries, move on to the next item. The program isn't perfect; don't let it drive you crazy!

**APPENDIX B: PRE-WORKSHOP SURVEY**

Page 1 of 3

**Your Language Learning Background**

Form Description

**Please enter your name in the space provided below.\*****Please enter your age in the space provided below.\*****What is(are) your native language(s)?\*****What is your gender?\***

- ☐ Male
- ☐ Female
- ☐ Prefer not to answer

**How many years have you studied English?\***

- ☐ Less than 1 year
- ☐ 1-2 years
- ☐ 3-4 years
- ☐ 5-6 years
- ☐ 7-8 years
- ☐ More than 8 years

**How long have you learned English in an English speaking country?\***

- ☐ Less than 6 months
- ☐ 6 months to 1 year
- ☐ 1-2 years
- ☐ 3-4 years
- ☐ 5-6 years
- ☐ 7-8 years
- ☐ More than 8 years





**In the past week, have you worked specifically on improving your English pronunciation?\***

- If yes, around how many minutes did you spend practicing English pronunciation in the past week?**

--	--

- ☐ Take English classes
- ☐ Talk with native speakers
- ☐ Private practice (speaking aloud when alone and checking pronunciation)
- ☐ Work with English teaching software (such as Rosetta Stone)
- ☐ Work with dictation software programs (such as Windows Speech Recognition)
- ☐ Work with voice search programs (such as Siri on the iPhone)
- ☐ Work with online resources and activities
- ☐ Watch English lessons available online
- ☐ Watch movies or videos in English for entertainment
- ☐ Focused listening (listening specifically for speaker's pronunciation)
- ☐ Use dictionaries
- ☐ Other:

[illegible]

### After the Pronunciation Workshop Survey

### Form Description

**Please enter your name in the space provided below.\***

Please rate the degree to which you agree or disagree with the following statements by checking the appropriate circle.\*

[illegible]

I need a native speaker to correct me on my pronunciation to improve.



I need a teacher to help me to improve my pronunciation.



I am aware of multiple strategies to practice my English pronunciation.



I am capable of successfully practicing my English pronunciation on my own.



I have resources and tools that can help me work on my pronunciation.



I can use technology to help me with my pronunciation.



I like trying new activities to improve my pronunciation.





**APPENDIX E: POST-WORKSHOP INTERVIEW QUESTIONS**

<b>Before Class</b>
How did you work on your pronunciation prior to taking part in the workshop?
<b>Changes in Feelings</b>
I'd like to talk to you about the survey you took before and after the workshop. Some of your feelings about the items seem to have changed. Let's go through each item that you scored differently and I would like you to tell me what changed for you.
<b>Repertoire</b>
In what ways (if any) do you feel this course helped you?
What things have you learned that have helped you to work on your pronunciation on your own, outside of class?
What is your plan of action to continue improving your pronunciation after this course?
How confident are you about your ability to continue improving your pronunciation? - Why?
<b>Work with Windows Speech Recognition</b>
Which, if any, of the learning strategies introduced during the course did you try outside of class?  <ul style="list-style-type: none"> <li>- For any of the three not mentioned, "Why not ____"?</li> <li>- If strategies include covert rehearsal or focused listening, "What were your reactions to using _____ for improving your pronunciation?"</li> <li>- If strategies include Windows Speech Recognition, then all questions below.</li> </ul>
What did you think of working with Windows Speech Recognition?
Did you feel comfortable using the program? - What increased or decreased your comfort level?
I'd like you to describe your latest experience using WSR. Walk me through the moment that you opened the program to the moment that you decided to stop working in that day.
In what ways, is Windows Speech Recognition helpful?
How many times, on average, would you say that you tried a particular example given on the handout? - How did you decide?
Did you ever choose or bring in other work into your practice with WSR? If so, what and why?

## APPENDIX F: LEARNING LOGS

### Question 1

Not yet answered

Marked out of 1.00

[Flag question](#)

[Edit question](#)

As part of the pronunciation workshop for 99L, you had work that you were supposed to do. How much time (around how many minutes) do you think you spent this week on the required pronunciation activities (including class time and required out of class listening and production work)?

Select one:

- ☐ a. 1-2 hours
- ☐ b. 6-7 hours
- ☐ c. 5-6 hours
- ☐ d. 4-5 hours
- ☐ e. More than 7 hours
- ☐ f. 3-4 hours
- ☐ g. 2-3 hours

### Question 2

Not yet answered

Marked out of 1.00

[Flag question](#)

[Edit question](#)

Please describe your reactions to the required work that you did this week.

Paragraph

B

I

Path: p

### Question 3

Not yet answered

Marked out of 1.00

[Flag question](#)

[Edit question](#)

Did you do anything this week to work on your pronunciation that was not required as part of the course?

Select one:

- ☐ a. Yes
- ☐ b. No

### Question 4

Not yet answered

Marked out of 1.00

[Flag question](#)

[Edit question](#)

Around how many minutes did you spend on this non-required work?

Select one:

- ☐ a. 1-15 minutes
- ☐ b. 2-3 hours
- ☐ c. 3-4 hours
- ☐ d. 45-60 minutes
- ☐ e. 30-45 minutes
- ☐ f. 1.5-2 hours
- ☐ g. 1-1.5 hours
- ☐ h. More than 4 hours
- ☐ i. 15-30 minutes

### Question 5

Not yet answered

Marked out of 1.00

[Flag question](#)

[Edit question](#)

Please describe what types of activities you did to work on your pronunciation this week outside of class (non-required work).

Paragraph

B

I

Path: p

### Question 6

Not yet answered

Not graded

[Flag question](#)

[Edit question](#)

Please describe your reactions to any non-required work that you did this week.

Paragraph

B

I

Path: p

**APPENDIX G: FOCUS GROUP QUESTIONS**

1. I'd like you to describe your experiences using Windows Speech Recognition as part of the pronunciation workshop.
2. What aspects of WSR did you find useful for pronunciation work?
3. What aspects of WSR did you find challenging for pronunciation work?
4. If you could change and improve WSR for pronunciation work, what features of the program would be different?
5. Have you continued using WSR since the end of the workshop?
6. What has motivated you to continue work with WSR or to stop using WSR?
7. What types of activities have you used with WSR?
8. In what ways, if any, do you plan to use WSR in the future?



**APPENDIX H: AVERAGE RESPONSE SCORE FOR EACH LIKERT SCALE ITEM BY GROUP (COMPLETE WITH SD)**

Likert Scale Item	TRAD Pre Ave	TRAD Pre SD	TRAD Post Ave	TRAD Post SD	STRAT Pre Ave	STRAT Pre SD	STRAT Post Ave	STRAT Post SD	HYBRID Pre Ave	HYBRID Pre SD	HYBRID Post Ave	HYBRID Post SD
I avoid talking with others in English because I am concerned about my pronunciation.	1.93	1.39	1.73	1.53	2.00	1.22	1.41	1.12	1.25	1.34	1.25	1.61
I care about my pronunciation in English.	3.73	1.67	3.67	1.40	4.29	0.99	4.35	0.49	3.75	1.24	4.00	1.32
I want to continue improving my pronunciation.	4.27	1.28	4.07	1.39	4.47	0.87	4.53	0.62	4.38	0.62	3.50	1.26
I practice my pronunciation in English frequently.	3.07	1.39	3.27	1.34	2.82	1.29	3.41	1.23	3.50	0.89	4.13	0.81
It is possible to improve my pronunciation.	3.80	1.61	3.87	1.46	3.94	0.97	4.06	1.03	4.19	0.75	4.44	0.63
I need to hear a native speaker to know how to pronounce a word correctly.	3.73	1.53	3.87	1.36	4.18	1.07	4.18	0.88	4.38	0.81	4.56	0.51
I need a native speaker to correct me on my pronunciation to improve	3.53	1.51	3.60	1.35	4.18	1.13	4.18	0.88	4.25	0.77	4.44	0.63
I need a teacher to help me to improve my pronunciation	3.73	0.96	3.80	1.32	4.06	1.30	4.00	0.61	4.19	0.83	4.38	1.09
I am aware of multiple strategies to practice my English pronunciation.	3.07	1.39	3.33	1.18	3.29	1.05	3.65	0.93	3.56	1.09	3.50	1.21
I am capable of successfully practicing my English pronunciation on my own.	2.80	0.86	3.07	1.39	2.82	0.95	3.12	0.60	3.06	1.00	3.31	1.08
I have resources and tools that can help me work on my pronunciation.	2.53	0.99	2.87	1.46	2.47	1.12	3.00	1.32	2.69	1.62	3.50	0.82
I can use technology to help me with my pronunciation.	2.67	1.45	2.93	1.44	3.12	1.17	3.47	1.07	2.94	1.39	3.50	0.97
I like trying new activities to improve my pronunciation.	3.93	1.16	3.60	1.55	3.41	1.23	3.71	0.77	3.81	0.91	4.06	0.77

## APPENDIX I: STUDENT GUIDE SHEET FOR WEEK 1 PRACTICE WITH WSR

### Activity: Word Pairs

Teen-Tin

Feel-Fill

Heed-Hid

Seat-Sit

### Activity: Word Pairs

Right-Light

Arrive-Alive

Fire-File

Heart- Hot

### Activity: Dialogue 1

Bill: I'd like to speak with Mr. Richardson, please.

Secretary: He isn't in this morning. He's ill.

Bill: When do you think I can see him?

Secretary: Sometime next week. How about Tuesday?

Bill: Okay.

Secretary: Is 3:15 (three fifteen) alright?

Bill: Fine. I'll see him then.

### Activity: Dialogue 2

A: Mr. Reed wants the paper by three.

B: What paper?

A: The report about government ratings.

B: Okay. That shouldn't be a problem. Should I email it or submit a hard copy?

A: Hard copy

### Activity: Tell me about your Saturday.

(Spend about a minute talking about your Saturday. Pay attention to when you use words that contain /r/, /i/, and /ɪ/. Check the transcript made by the Speech Recognition. Only focus on words with the target sounds.)